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Qualification Guidelines for Personal Computer-Based Aviation Training Devices: Private Pilot Certificate

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16. Abstract

As part of the development of qualification guidelines for a personal computer-based aviation training device (PCATD), a task analysis of flight tasks for the private pilot certificate has been completed and is reported in this paper. The primary goal of the task analysis was to identify training device requirements for supporting specific private pilot maneuvers. Before PCATDs can be authorized for use as qualified and approved training devices within a private pilot flight training course, a set of qualification guidelines must be developed for use by the FAA in evaluating such potential training devices. This task analysis constitutes the first steps in the development of those qualification guidelines.

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Qualification Guidelines for Personal Computer-Based Aviation Training Devices: Private Pilot Certificate

As part of the development of qualification guidelines for a personal computer-based aviation training device (PCATD), a task analysis of flight tasks for the private pilot certificate has been completed and is reported in this paper. The primary goal of the task analysis was to identify training device requirements for supporting specific private pilot maneuvers. It is believed that if these maneuvers can be emulated satisfactorily using the training device, there will be positive training transfer of the maneuvers to the actual aircraft. There is a growing body of evidence that supports the effectiveness of PCATDs for both private and instrument flight training (Dennis & Harris, 1998; Koonce & Bramble, 1998; Ortiz, 1994; Taylor et al., 1999). However, before these devices can be authorized for use as qualified and approved PCATDs within a private pilot flight training course, a set of qualification guidelines must be developed for use by the FAA in evaluating such potential training devices. This task analysis constitutes the first steps in the development of those qualification guidelines.

This paper in no way constitutes the Federal Aviation Administration's (FAA's) endorsement of the use of a PCATD other than as stated herein. The FAA's current authorization for the use of a qualified and approved PCATD is limited solely to its use in training for an instrument rating as part of an integrated ground and flight instrument curriculum in accordance with AC No. 61-126 (DOT, 1997), Qualification and Approval of Personal Computer-Based Aviation Training Devices. Until the FAA is able to compile sufficient, valid, and usable data regarding the effective use of a PCATD as authorized above, no further authorization for use is considered appropriate or likely. The FAA would have no objection to a qualified and approved PCATD being used solely to support the ground training element of a private pilot curriculum, such as that currently available from Jeppesen Sanderson.

In addition to the task analysis, task-specific qualification guidelines have been developed for each of the flight tasks listed. The purpose of this paper is to present the analysis and to provide the reader with an understanding of the process and reasoning used to conduct the analysis. This document is the second of a series of task analyses that have been conducted. The first, reported in Williams (1996), focused on instrument flight tasks. This work extends the analysis to the visual flight world and allows for the eventual development of an approved set of guidelines regarding PCATD use for visual flight training.

Guideline Use

Use of the qualification guidelines is explained in a separate paper (Williams & Blanchard, 1995) and in the appendix. When used appropriately, the qualification guidelines will enable a pilot school to gain approval for the use of a PCATD in an integrated ground and flight training curriculum under Part 141 of the Federal Air Regulations (FAR).

Developing the Flight Task Database

The first step in the analysis involved the development of a flight task database for private pilot certificate flight tasks. The information came from several sources. The first source was the Private Pilot Practical Test Standards (DOT, 1995). These standards provided a list of tasks required to acquire a single-engine land, private pilot certificate, along with minimum performance criteria for each task. However, the Practical Test Standards only list those tasks that would be required as part of the certification practical test. They do not list all of the tasks that would commonly be taught during a course of training for the private pilot certificate. Other sources of information included syllabi from selected Part 141 flight schools, flight training manuals, and interviews with pilots. The resulting database was reviewed and approved by certified flight instructors (CFIs) as well as Flight Standards District Office (FSDO) inspectors. Table 1 presents the flight task database for the private pilot certificate used in the task analysis. While it might not include every task taught during a normal private pilot course, an attempt was made to include all of those tasks that would be trainable using a suitably equipped PCATD.

Table 1. Flight Task Listing for Private Pilot Certificate.

1.0 Preflight Preparation
- 1.1 Certificates and Documents
- 1.2 Weather Information
- 1.3 Cross-Country Flight Planning
- 1.4 National Airspace System
- 1.5 Performance and Limitations
- 1.6 Operation of Systems
- 1.7 Minimum Equipment List
- 1.8 Aeromedical Factors

2.0 Preflight Procedures
- 2.1 Preflight Inspection
- 2.2 Cockpit Management
- 2.3 Engine Starting
- 2.4 Taxiing
- 2.5 Pre-takeoff Check

3.0 Airport Operations
- 3.1 Radio Communications
- 3.2 ATC Light Signals
- 3.3 Traffic Pattern Operations
- 3.4 Airport and Runway Marking and Lighting

4.0 Basic Visual Flight Maneuvers
- 4.1 Straight-and-Level Flight
- 4.2 Airspeed Transitions
- 4.3 Constant Airspeed Climbs
- 4.4 Constant Airspeed Descents
- 4.5 Level Turns
- 4.6 Climbing Turns
- 4.7 Descending Turns
- 4.8 Steep Turns

5.0 Takeoffs, Landings, and Go-Arounds
- 5.1 Takeoff and Climb
- 5.2 Approach and Landing
- 5.3 Go-Arounds From a Rejected Landing
- 5.4 Forward Slips to Landing
- 5.5 Short-Field Takeoff and Climb
- 5.6 Soft-Field Takeoff and Climb
- 5.7 Short-Field Approach and Landing
- 5.8 Soft-Field Approach and Landing

6.0 Ground Reference Maneuvers
- 6.1 Rectangular Courses
- 6.2 S-Turns Across a Road
- 6.3 Turns Around a Point

7.0 Navigation
- 7.1 Pilotage and Dead Reckoning
- 7.2 Navigation Systems and Radar Services
- 7.3 Diversion
- 7.4 Lost Procedures

8.0 Slow Flight and Stalls
- 8.1 Flight at Slow Airspeeds
- 8.2 Power-Off Stalls
- 8.3 Power-On Stalls
- 8.4 Spin Awareness

9.0 Basic Instrument Maneuvers
- 9.1 Straight-and-Level Flight
- 9.2 Constant Airspeed Climbs
- 9.3 Constant Airspeed Descents
- 9.4 Turns to Headings
- 9.5 Unusual Flight Attitudes
- 9.6 Radio Communications

10.0 Emergency Operations
- 10.1 Emergency Descent
- 10.2 Emergency Approach and Landing

11.0 Night Operations
- 11.1 Night Preparation
- 11.2 Night Flight

Analysis of the Flight Task Database

Data for the analysis came from several sources including: interviews with flight instructors from certificated pilot schools; Private Pilot Practical Test Standards (DOT, 1995); a commercially developed pilot maneuvers guide (Jeppesen Sanderson, 1989), the Flight Training Handbook (DOT, 1980), and the Aeronautical Information Manual (DOT, 1999). The analysis of each task was divided into four sections. The first section is a statement of the learning objectives for that task. The learning objectives for each task were identified by an analysis of task objectives and criteria, task nomenclature, particular controls and displays utilized during the performance of that task, environmental information used in the task, and movements and procedures required to complete each task. The summarization of learning objectives differs for various tasks depending on the type of task, the complexity of the task, and the degree to which the task relies on previously learned objectives. Some task learning objectives are stated in the form of a summary paragraph while others are broken down in the form of subtasks and task elements, depending on the level of analysis that was required to specify input and output requirements for the task. The learning objectives of each task were analyzed to the extent necessary to make a clear statement of the inputs (from the PCATD) and outputs (to the PCATD) required to perform that task. These inputs and outputs comprise the second section of the task analysis.

The second section of the task analysis consists of a listing of the user inputs and outputs required to perform that task. Note that an input to the user is an output from somewhere else (primarily the PCATD) so potential confusion can arise if it is not kept clear who is receiving the inputs and giving the outputs. In this analysis, the user is the focal point. So for any task, it is important to specify what inputs the user receives from the PCATD and what outputs the user must provide to the PCATD to perform the specific task.

The third section of the task analysis is a statement of the training considerations that are relevant to that task. These training considerations concern how training on that task is accomplished. These considerations include items such as the initial conditions of the task (i.e., the state of the simulation at the beginning of performance of a task), how certain task parameters should vary during practice on the task, and any special training requirements that are peculiar to that task.These considerations do not determine whether or not training transfer occurs for that task, but they will affect the quality of the training received by correctly performing the task.

Developing a Prototype Set of Qualification Guidelines

The fourth section of each task analysis is a translation of the data in the previous three sections into a set of training device qualification guidelines for that task. The guidelines are divided into four categories: 1) controls, 2) displays, 3) flight dynamics, and 4) instructional management. These categories were used in the analysis of instrument flight tasks (Williams, 1996), and were also incorporated into the advisory circular AC 61-126 used to qualify PCATDs for instrument training (DOT, 1997). The first three categories deal with the simulation of flight and the aircraft cockpit. Instructional management characteristics of the device manage the nature, and kind of training, that can be accomplished using the device.

The development of guidelines was accomplished with two assumptions in mind. The first is that the aircraft simulated is a single engine, fixed gear, basic training aircraft with a fixed-pitch propellor. The second assumption is that the PCATD will be used as part of an organized flight training curriculum, and all practice on the device will be accomplished under supervision of a qualified flight instructor.

Baseline Qualification Guidelines

As was done for instrument training tasks, a baseline set of qualification guidelines has been identified on which to build. This baseline set of guidelines will be required for any PCATD used in an integrated ground and flight training program. Task specific guidelines given as a result of the task analysis will note only those qualification guidelines that are in addition to those given in the baseline.

This section includes a general summary of the baseline PCATD qualification guidelines discussed above. The guidelines specify general device characteristics that any PC-based simulation device must possess, regardless of the type of training for which it is used. These guidelines are divided into four categories: (1) controls, (2) displays, (3) flight dynamics, and (4) instructional management.

Controls

Controls used in the PC-based simulation device can be of two types: physical and virtual. Both types of controls should be recognizable as to their function and how they can be manipulated solely from their appearance. This requirement eliminates the use of a keyboard to control the simulated aircraft (although a keyboard may still be used in controlling aspects of the simulation such as setting initial aircraft state, location, wind, etc.).

A physical control is an actual physical object that, when manipulated, provides input to the flight simulation. In contrast, a virtual control is defined here as a realistic graphical representation of a physical control, displayed on the computer screen, that can be unambiguously manipulated through the use of a computer input device. An example of a virtual control is a realistic-looking flaps switch that is displayed on the computer screen and manipulated through any computer cursor-control device, such as a mouse, or more directly with touch-screen technology. The cursor is positioned on the flaps switch and "pressed" by an appropriate action with the input device. A virtual control provides a sense of direct manipulation of a control without requiring the presence of external hardware. It should be noted that this definition of virtual control differs from the one given in AC 61-126. That document does not provide for any virtual controls in the sense used here. According to the advisory circular, all aircraft controls must be physical controls. Because there is no research to support the training effectiveness of virtual controls, the requirement to make all aircraft controls physical is the most prudent. However, it seems reasonable that for certain actions, especially those that do not require a great deal of psychomotor skill such as pushing a button or turning a knob, the use of a virtual control can still provide effective training. The baseline qualification guidelines for controls are as follows:

1. A physical, self-centering, displacement yoke or control stick that allows continuous adjustment to the rate of change of pitch and bank.
2. Physical, self-centering rudder pedals that allow continuous adjustment to the rate of change of yaw.
3. A physical throttle control that allows continuous movement from idle to full power settings.
4. Physical or virtual controls for flaps and pitch trim. It is not necessary that the pitch trim control relieve control pressure as it does in an actual aircraft. However, the pitch trim control might allow the simulated aircraft to be stabilized at any particular pitch attitude with the yoke or control stick in the neutral position.
5. Time from control input to recognizable system response (transport delay) should be 300 milliseconds or less

Displays

Displays are representations of the cockpit instruments, rather than a computer console per se, although that is where they usually appear. It has been found that the use of a 19-inch monitor provides cockpit instrument representations that are close to actual size; however, because the monitor can be positioned closer to the pilot than actual cockpit instruments, it is not really necessary to have a monitor that large for the instruments to assume the same visual angle. Besides, there is no research to indicate that there is any training advantage to having a display that is the same size as that found in the cockpit. The primary requirement is that the displays are readable from the normal pilot position, that the layout be similar to an actual aircraft, and that the "general look" of the display be the same as the actual aircraft instruments. Baseline qualification guidelines for displays are as follows:

6. Represented displays should include an altimeter, heading indicator, airspeed indicator, vertical speed indicator, turn and bank coordinator, attitude indicator, tachometer, flaps setting, pitch trim indication, and a magnetic compass.
7. Relative layout of the primary displays must correspond to the standard "T" configuration with (a) airspeed, (b) attitude and (c) altimeter forming the "cap" with (d) heading indicator, located in the "stem" below the attitude indicator.
8. The size, shape, and information content of displays should closely resemble those found commonly in a single-engine, fixed-pitch propeller, basic training aircraft with a fixed gear.
9. Display update should be 10Hz or faster.
10. The smallest display changes should be discriminable from the pilot's normal operating position and correspond to the following information:

Airspeed indicator	Change of 5 kts. or less in airspeed
Attitude indicator	Change of 2° or less pitch or bank
Altimeter	Change of 10 ft. or less in altitude
Turn and bank	Change of 1/4 standard rate turn or less
Heading indicator	Change of 2° or less in heading
VSI	Change of 100 fpm or less in vertical speed
Tachometer	Change of 25 RPM or less in engine power output

11. Displays should reflect the dynamic behavior of an actual aircraft display (e.g., VSI reading of –500 fpm is reflected by a corresponding movement in altimeter, an increase in throttle is reflected by an immediate increase in RPM indicator, etc.).
12. Device should have a forward, out-the-window display, representing at least a 45° horizontal field of view, and a 30° vertical field of view. The out-the-window display should include a horizon, useful visual references for monitoring the path of the aircraft, and an aircraft reference (i.e., nose of the aircraft) for the performance of ground-referenced maneuvers.

Flight Dynamics

Flight dynamics refers to the manner in which aircraft characteristics are modelled within the simulation. It is understood that every plane has slightly different flight dynamics, but it should still be possible to create a simulation that is consistent with a certain class of aircraft. The baseline qualification guidelines for flight dynamics are as follows:

13. Flight dynamics of the simulated aircraft should be consistent with a single-engine, fixed gear, basic training aircraft with a fixed-pitch propeller.
14. Aircraft performance parameters (maximum speed, cruise speed, stall speed, and maximum climb rate) should be consistent with a single-engine, fixed gear, basic training aircraft with a fixed-pitch propeller.
15. Aircraft vertical lift component should change as a function of bank, consistent with a single-engine, fixed gear, basic training aircraft with a fixed-pitch propeller.
16. Changes in flap setting should be accompanied by appropriate changes in flight dynamics.

Instructional Management

The training effectiveness of the PCATD is influenced to a great extent by its instructional management characteristics. Instructional management refers to the ability to control a training session. This control could be initiated either from the same system that is handling the aircraft simulation, or from a separate, but interconnected "trainer's station". The baseline qualification guidelines for instructional management are as follows:

17. The user should be able to pause the system at any point for the purpose of receiving instruction regarding the task.
18. For the purpose of beginning a training session with the aircraft already in the air and ready for the performance of a particular maneuver, the user should be able to manipulate the following system parameters independently of the simulation:

    Geographic aircraft location (location within the available digitized space)
    Aircraft heading
    Aircraft airspeed
    Aircraft altitude
    Engine RPM

19. The system should be capable of recording both a horizontal and vertical track of aircraft position during the performance of a task for later playback and review.

Tables 2 through 12 present the complete task analysis for the private pilot certificate. A separate table is given for each of the 11 task sets identified in Table 1. Following the tables is a summary that provides a listing of all of the additional guidelines and provides a cross-reference between each task and the guidelines.

Table 2. Private Pilot Certificate Task Analysis: Preflight Preparation

Authorization: Private Pilot Certificate
Task Set: 1.0 Preflight Preparation
Task: 1.1 Certificates and documents

Learning Objectives

The learning objective of this task is to acquire the knowledge of elements related to certificates and documents, including: 1) pilot certificate, privileges, and limitations; 2) medical certificate, class, and duration; and 3) required entries in the pilot logbook or flight record. In addition, the trainee must acquire knowledge of the location and purpose of the following: 1) airworthiness and registration certificates; 2) operating limitations placards, instrument markings, handbooks and manuals; 3) weight and balance data, including the equipment list; 4) airworthiness directives and compliance records; and 5) maintenance requirements, tests, and appropriate records.

Input Requirements:

- all certificate and document information listed above

Output Requirements:

- demonstration of understanding of all certificate and document information listed above

Training Considerations

The demonstration of an understanding of certificates and documents can be accomplished using the PCATD by having the system elicit information from the trainee through multiple choice questions, filling in blanks, etc. At a minimum, the system should provide feedback to the student regarding areas in need of review.

Device Qualification Guidelines

Displays:
The PCATD can display all of the various certificate and document-related information.

Instructional Management:
The PCATD can test knowledge of certificates and documents through multiple choice questions, fill-in-the blanks, etc. and provide feedback on areas of knowledge that are lacking.

Authorization: Private Pilot Certificate
Task Set: 1.0 Preflight Preparation
Task: 1.2 Obtaining weather information

Learning Objectives

The learning objective of this task is to acquire the ability to obtain, read, and analyze aviation weather information including the following: 1) PIREPs; 2) SIGMETs and AIRMETs; and 3) wind shear reports. A further learning objective is to obtain the ability to make a competent "go/no-go" decision based on the assembled weather information.

Input Requirements:

- weather information in all formats listed above

Output Requirements:

- demonstration of understanding of weather information in all formats listed above
- generation of a "go/no-go" decision based on the assembled weather information

Training Considerations

The demonstration of an understanding of weather information can be accomplished using the PCATD by having the system elicit information from the trainee through multiple choice questions, filling in blanks, etc. At a minimum, the system should provide feedback to the student regarding areas in need of review.

Device Qualification Guidelines

Displays:
The PCATD can display all of the various forms of weather-related information.

Instructional Management:
The PCATD tests knowledge of weather through multiple choice questions, fill-in-the blanks, etc. and provides feedback on areas of weather-related knowledge that are lacking.

Authorization: Private Pilot Certificate
Task Set: 1.0 Preflight Preparation
Task: 1.3 Cross-country flight planning

Learning Objectives

1.3.1 Perform preliminary weather check

1.3.2 Select tentative route(s) to destination airports and alternate(s)
- 1.3.2.1 Select a proposed altitude for each route
- 1.3.2.2 Select route segments and easily identifiable checkpoints
- 1.3.2.3 Correct for true and magnetic course readings
- 1.3.2.4 Compute distances for each route segment
- 1.3.2.5 Record communication and navigation frequencies to be used during the flight

1.3.3 Gather current information on facilities and procedures related to flight
- 1.3.3.1 Check Airport/Facility Directory for airport conditions regarding lighting, obstructions, and other notations under "Airport Remarks." Also, check services at destination airport and alternate(s)
- 1.3.3.2 Check Notices to Airmen (Class II, FDC NOTAMS)

1.3.4 Contact Flight Service Station (FSS) or Automated Flight Service Station (AFSS) for preflight briefing

1.3.5 Complete flight log
- 1.3.5.1 Compute true airspeed, wind data, and groundspeed
- 1.3.5.2 Compute estimated time enroute
- 1.3.5.3 Compute estimated time between check points
- 1.3.5.4 Compute fuel required

1.3.6 Compute weight and balance

1.3.7 Complete flight plan (FAA Form 7233-1) and file with FSS or AFSS at least 30 minutes before estimated departure time

Input Requirements:
- weather information in all formats listed under Task 1.2
- navigational chart information containing proposed route of flight, destination airport and at least one alternate airport
- facilities information from Airport/Facility Directory and NOTAMS

Output Requirements:
- selected routes to destination airports and alternate(s)
- analysis of assembled weather information pertaining to a proposed route of flight and destination airport
- determination of whether an alternate airport is required and, if required, whether the selected alternate meets the regulatory requirement
- flight log information
- weight and balance information
- flight plan

Training Considerations

Much of the information required to complete this task can be provided independently of the computer. This includes an Airport/Facility Directory, NOTAMS, and instrument approach procedure charts. The PCATD should ensure the trainee understands the use of this information by controlling the completion of a flight log and flight plan and by providing feedback on errors in the computation of various flight parameters (distances, headings, airspeeds, etc.).

Device Qualification Guidelines

Displays:
The PCATD can display all of the various forms of weather-related information.
The PCATD can display a navigational chart and information related to the airports located on that chart.
The PCATD can display a flight log and a flight plan.

Instructional Management:
The PCATD provides feedback regarding the selection of route segments and checkpoints, the computation of headings, distances, airspeed, wind data, ground speed, time en route, estimated time between check points, fuel required, weight and balance, and the correct procedure for completing and filing a flight plan.

Authorization: Private Pilot Certificate
Task Set: 1.0 Preflight Preparation
Task: 1.4 National Airspace System

Learning Objectives

The learning objective of this task is to acquire the knowledge of elements related to the National Airspace System including: 1) basic VFR weather minimums for all classes of airspace; 2) boundaries, pilot certification, and airplane equipment for Class A, B, C, D, E, and G airspace; and 3) special use airspace and other airspace areas.

Input Requirements:

- all airspace information listed above

Output Requirements:

- demonstration of an understanding of all airspace information listed above

Training Considerations

The demonstration of an understanding of airspace system information can be accomplished using the PCATD by having the device elicit information from the trainee through multiple choice questions, filling in blanks, etc. At a minimum, the device should provide feedback to the student regarding areas in need of review.

Device Qualification Guidelines

Displays:
The PCATD can display all of the required national airspace system information.

Instructional Management:
The PCATD tests knowledge of the national airspace system through multiple choice questions, fill-in-the blanks, etc. and provides feedback on areas of knowledge that are lacking.

Authorization: Private Pilot Certificate
Task Set: 1.0 Preflight Preparation
Task: 1.5 Aircraft performance and limitations

Learning Objectives

The learning objective of this task is to: 1) acquire knowledge of aircraft performance and limitations, as reflected in performance charts, tables, and data; 2) compute weight and balance, including adding, removing, and shifting weight,

and determining if weight and center of gravity will remain within limits during all phases of flight; 3) acquire knowledge of the effects of atmospheric conditions on the airplane's performance; and 4) determine whether computed performance is within the airplane's capabilities and operating limitations.

Input Requirements:

- information about aircraft performance and limitations
- performance charts, tables, and data for a generic training aircraft
- weight and balance information for a generic training aircraft

Output Requirements:

- demonstration of understanding of aircraft performance and limitations
- demonstration of use of performance charts, tables, and data
- computation of weight and balance
- demonstration of understanding of effects of atmospheric conditions on airplane performance
- determination that the computed performance is within the airplane's capabilities and operating limitations

Training Considerations

The demonstration of an understanding of aircraft performance and limitations can be accomplished using the PCATD by having the system elicit information from the trainee through multiple choice questions, filling in blanks, etc. A generic aircraft model can be used to derive performance parameters. At a minimum, the system should provide feedback to the student regarding areas in need of review.

Device Qualification Guidelines

Displays:
The PCATD can display all of the required information on aircraft performance and limitations.

Instructional Management:
The PCATD tests knowledge of aircraft peformance and limitations through multiple choice questions, fill-in-the blanks, etc. and provides feedback on areas of knowledge that are lacking.

Authorization: Private Pilot Certificate
Task Set: 1.0 Preflight Preparation
Task: 1.6 Operation of systems

Learning Objectives

The learning objective of this task is to acquire knowledge of aircraft systems and their operating characteristics including: 1) primary flight controls and trim; 2) flaps, leading edge devices, and spoilers; 3) powerplant; 4) propeller; 5) landing gear; 6) fuel, oil, and hydraulic systems; 7) electrical system; 8) pitot-static system, vacuum/pressure system and associated flight instruments; 9) environmental system; 10) deicing and anti-icing systems; and 11) avionics system.

Input Requirements:

- information of aircraft systems and their operating characteristics

Output Requirements:

- demonstration of understanding of aircraft systems and their operating characteristics

Training Considerations

The Practical Test Standards require that only three of the eleven systems be tested, however, all systems should be learned. The demonstration of an understanding of aircraft systems and their operating characteristics can be accomplished using the PCATD by having the system elicit information from the trainee through multiple choice questions, filling in blanks, etc. At a minimum, the system should provide feedback to the student regarding areas in need of review for each of the aircraft systems listed above.

Device Qualification Guidelines

Displays:
The PCATD can display all of the required information on aircraft systems and their operating characteristics.

Instructional Management:
The PCATD tests knowledge of aircraft systems and their operating characteristics through multiple choice questions, fill-in-the blanks, etc. and provides feedback on areas of knowledge that are lacking.

Authorization: Private Pilot Certificate
Task Set: 1.0 Preflight Preparation
Task: 1.7 Minimum equipment list

Learning Objectives

The learning objective of this task is to acquire knowledge of the use of an approved Part 91 minimum equipment list, including: 1) required instruments and equipment for day VFR and night VFR flight; 2) procedures for operating the airplane with inoperative instruments and equipment; and 3) requirements and procedures for obtaining a special flight permit.

Input Requirements:

- information of required instruments and equipment for day VFR and night VFR flight
- information regarding procedures for operating the airplane with inoperative instruments and equipment
- information of requirements and procedures for obtaining a special flight permit

Output Requirements:

- demonstration of understanding of required instrument and equipment for day VFR and night VFR flight
- demonstration of understanding of procedures for operating the airplane with inoperative instruments and equipment
- demonstration of understanding of requirements and procedures for obtaining a special flight permit

Training Considerations

The demonstration of an understanding of minimum equipment lists can be accomplished using the PCATD by having the system elicit information from the trainee through multiple choice questions, filling in blanks, etc. At a minimum, the system should provide feedback to the student regarding areas in need of review for each of the areas listed above.

Device Qualification Guidelines

Displays:
The PCATD can display all of the required information about the content and use of minimum equipment lists.

Instructional Management:
The PCATD tests knowledge of the content and use of minimum equipment lists through multiple choice questions, fill-in-the blanks, etc. and provides feedback on areas of knowledge that are lacking.

Authorization: Private Pilot Certificate
Task Set: 1.0 Preflight Preparation
Task: 1.8 Aeromedical factors

Learning Objectives

The learning objective of this task is to acquire knowledge of elements related to aeromedical factors including: 1) the symptoms, causes, effects, and corrective actions of a. hypoxia, b. hyperventilation, c. middle ear and sinus problems, d. spatial disorientation, e. motion sickness, f. carbon monoxide poisoning, and g. stress and fatigue; 2) the effects of alcohol and over-the-counter drugs; and 3) the effects of nitrogen excesses acquired during scuba dives upon subsequent altitude exposure as a pilot or passenger.

Input Requirements:

- information of the aeromedical factors listed above

Output Requirements:

- demonstration of an understanding of the aeromedical factors listed above

Training Considerations

The Practical Test Standards require testing of only three of the items listed under the first learning objective; however, all of the items should be learned. The demonstration of an understanding of aeromedical factors can be accomplished using the PCATD by having the system elicit information from the trainee through multiple choice questions, filling in blanks, etc. At a minimum, the system should provide feedback to the student regarding areas in need of review.

Device Qualification Guidelines

Displays:
The PCATD can display all of the required information about aeromedical factors.

Instructional Management:
The PCATD tests knowledge of aeromedical factors through multiple choice questions, fill-in-the blanks, etc. and provides feedback on areas of knowledge that are lacking.

Table 3. Private Pilot Certificate Task Analysis: Preflight Procedures

Authorization: Private Pilot Certificate
Task Set: 2.0 Preflight Procedures
Task: 2.1 Preflight inspection

Learning Objectives

The learning objective of this task is to acquire knowledge of elements related to preflight inspection, including which items must be inspected, the reasons for checking each item, and how to detect defects.

Input Requirements:

- information related to preflight inspection

Output Requirements:

- demonstration of understanding of preflight inspection

Training Considerations

The demonstration of an understanding of preflight inspection can be accomplished using the PCATD by having the system elicit information from the trainee through multiple choice questions, filling in blanks, etc. At a minimum, the system should provide feedback to the student regarding areas in need of review.

Device Qualification Guidelines

Displays:
The PCATD can display all of the required information about preflight inspection.

Instructional Management:
The PCATD tests knowledge of preflight inspection through multiple choice questions, fill-in-the blanks, etc. and provides feedback on areas of knowledge that are lacking.

Authorization: Private Pilot Certificate
Task Set: 2.0 Preflight Procedures
Task: 2.2 Cockpit management

Learning Objectives

The learning objective of this task is to acquire knowledge of elements related to cockpit management procedures, including the securing of loose items, use of safety belts, shoulder harnesses, passenger emergency procedures, and the organization of material and equipment within the cockpit.

Input Requirements:

- information related to cockpit management procedures

Output Requirements:

- demonstration of understanding of cockpit management procedures

Training Considerations

The demonstration of an understanding of cockpit management procedures can be accomplished using the PCATD by having the system elicit information from the trainee through multiple choice questions, filling in blanks, etc. At a minimum, the system should provide feedback to the student regarding areas in need of review.

Device Qualification Guidelines

Displays:
The PCATD can display all of the required information about cockpit management procedures.

Instructional Management:
The PCATD tests knowledge of cockpit management procedures through multiple choice questions, fill-in-the blanks, etc. and provides feedback on areas of knowledge that are lacking.

Authorization: Private Pilot Certificate
Task Set: 2.0 Preflight Procedures
Task: 2.3 Engine starting

Learning Objectives

2.3.1 Position the airplane properly for engine start, considering open hangars, other aircraft, the safety of nearby persons and property on the ramp, and surface conditions.

2.3.2 Accomplish starting procedure
- 2.3.2.1 Set wheel brakes
- 2.3.2.2 Place carburetor heat control in COLD position
- 2.3.2.3 Set mixture control to RICH
- 2.3.2.4 Turn unnecessary electrical units OFF
- 2.3.2.5 Pump primer control as required
- 2.3.2.6 Open throttle 1/2 inch
- 2.3.2.7 Verbally and visually clear propeller area
- 2.3.2.7 Turn master switch to ON
- 2.3.2.9 Rotate or press ignition switch until engine starts
- 2.3.2.10 Turn master switch to BOTH

2.3.3 Complete post-start procedure
- 2.3.3.1 Adjust throttle to low power setting
- 2.3.3.2 Check if oil pressure is within acceptable limits
- 2.3.3.3 Shut down engine if oil pressure does not register properly within 30 s in warm weather and within 60 s in cold weather

Input Requirements:

- carburetor heat status
- mixture control status
- throttle setting
- master switch status
- ignition switch position
- oil pressure status
- brake status

Output Requirements:

- carburetor heat setting
- mixture control setting
- throttle setting
- master switch setting
- ignition switch setting
- brake setting

Training Considerations

Since some of the tasks require activities that are clearly outside the scope of the training device environment (e.g., visually clearing the propeller area), they will be ignored in the specification of device qualification guidelines.

Device Qualification Guidelines

Baseline qualification guidelines (see p. 5)

Controls:
Physical or virtual control for the following:
carburetor heat
mixture control
master switch
brake
Physical or virtual control for ignition switch

Displays:
The PCATD should have an oil pressure guage.
The PCATD should have a visual or aural indication that the engine is on.

Authorization: Private Pilot Certificate
Task Set: 2.0 Preflight Procedures
Task: 2.4 Taxiing

Learning Objectives

2.4.1 Position flight controls properly for existing wind conditions

2.4.2 Performs brake check immediately after the airplane begins moving

2.4.3 Controls direction and speed without excessive use of brakes

2.4.4 Complies with airport markings, signals, and ATC clearances

2.4.5 Avoids other aircraft and hazards

Input Requirements:

- flight control position
- power setting
- aircraft position at airport
- wind direction
- brake status

Output Requirements:

- flight control position
- power setting
- rudder position
- brake setting

Training Considerations

The simulation of wind effects is not as important as learning to make general adjustments to the flight controls according to the wind direction. Most private pilot maneuvers manuals suggest that proper control positioning should be practiced on every flight, regardless of the wind conditions. The instructor can provide ATC clearance instructions and wind directions.

Device Qualification Guidelines

Baseline qualification guidelines (see p. 5)

Displays:
Out-the-window display should include airport runway and taxiways

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Authorization: Private Pilot Certificate
Task Set: 2.0 Preflight Procedures
Task: 2.5 Pretakeoff Check

Learning Objectives

2.5.1 Position airplane properly, considering other aircraft, wind, and surface conditions

2.5.2 Divide attention inside and outside of cockpit

2.5.3 Accomplish pretakeoff check
- 2.5.3.1 Set wheel brakes
- 2.5.3.2 Check wing flaps for operation and set for takeoff
- 2.5.3.3 Check flight controls for free and proper operation
- 2.5.3.4 Set trim tabs for takeoff
- 2.5.3.5 Adjust altimeter to reported altimeter setting or field elevation
- 2.5.3.6 Set heading indicator to correspond with compass heading
- 2.5.3.7 Set mixture control to RICH
- 2.5.3.7 Set carburetor heat control to COLD
- 2.5.3.9 Check engine temperature
- 2.5.3.10 Adjust throttle to runup RPM
- 2.5.3.11 Check each magneto for operation
- 2.5.3.12 Set magneto switch to BOTH
- 2.5.3.13 Check engine instruments for normal indications
- 2.5.3.14 Check engine idle speed
- 2.5.3.15 Check seat locked and seatbelt fastened
- 2.5.3.16 Obtain takeoff clearance (if required)

2.5.3.17 Check cabin door locked
2.5.3.18 Check runway and final approach for aircraft
2.5.3.19 Recall takeoff "V-speeds" (critical performance speeds)

Input Requirements:

- carburetor heat status
- mixture control status
- throttle setting
- master switch status
- oil pressure status
- brake status
- altitude setting
- compass reading
- heading indicator reading
- flap status
- trim status

Output Requirements:

- carburetor heat setting
- mixture control setting
- throttle setting
- master switch setting
- ignition switch setting
- brake setting
- altitude setting
- heading indicator setting
- flap setting
- trim setting

Training Considerations

Some of the tasks can be checked off without any real action taken if the training device does not support the task. For example, adjustment of the seat, checking for locked doors, and scanning for approaching aircraft or aircraft on the runway can be checked off with little or no action taken. Instructor can act as ATC for purposes of providing clearances.

Device Qualification Guidelines

Baseline qualification guidelines (see p. 5)

Controls:
Physical or virtual control for the following:
carburetor heat
mixture control
master switch
brake
Physical or virtual control for the following:
alititude setting adjustment
heading indicator adjustment

Displays:
The PCATD should have an oil pressure guage.
Altitude indicator should have a barometric pressure indicator.
Out-the-window view should be capable of showing runway features and markings.

Table 4. Private Pilot Certificate Task Analysis: Airport Operations

Authorization: Private Pilot Certificate
Task Set: 3.0 Airport Operations
Task: 3.1 Radio communications

Learning Objectives

3.1.1 Tune communication radio to appropriate frequency

3.1.2 Transmit using recommended phraseology

3.1.3 Acknowledge and comply with ATC instructions

Input Requirements:

- pitch, bank, and yaw attitude
- rate of change of pitch, bank, and yaw
- altitude
- heading
- airspeed
- power setting
- radio communications from ATC

Output Requirements:

- rate of change of pitch, bank, and yaw
- engine power output
- radio communications with ATC

Training Considerations

Communication with ATC can be performed while engaged in almost any flight activity, but initial practice should begin while stationary on the ground, using the PCATD as a training aid for part-task training. Later practice would incorporate the flight simulation capabilities of the PCATD for full-task training (i.e., while holding a particular heading, altitude, and speed). The system should provide feedback regarding the maintenance of heading within 10°, airspeed within 10 kts, bank within 5°, and altitude within 100 ft. ATC communications can be provided by the instructor.

Device Qualification Guidelines

Baseline qualification guidelines (see p. 5)

Controls:
Physical communications radio microphone

Authorization: Private Pilot Certificate
Task Set: 3.0 Airport Operations
Task: 3.2 ATC light signals

Learning Objectives

The learning objective of this task is to acquire the knowledge of elements related to ATC light signals

Input Requirements:

- ATC light signal information

Output Requirements:

- demonstration of understanding of ATC light signals

Training Considerations

The demonstration of an understanding of ATC light signals can be accomplished using the PCATD by having the system elicit information from the trainee through multiple choice questions, filling in blanks, etc. At a minimum, the system should provide feedback to the student regarding areas in need of review.

Device Qualification Guidelines

Displays:
The PCATD can display all ATC light signal information.

Instructional Management:
The PCATD can test knowledge of ATC light signals through multiple choice questions, fill-in-the blanks, etc. and provide feedback on areas of knowledge that are lacking.

Authorization: Private Pilot Certificate
Task Set: 3.0 Airport Operations
Task: 3.3 Traffic pattern operations

Learning Objectives

3.3.1 Enter traffic pattern
- 3.3.1.1 Use appropriate advisory frequency to obtain local weather, traffic, and landing information prior to entering the pattern
- 3.3.1.2 Employ appropriate entry procedures for controlled or uncontrolled airport
- 3.3.1.3 Enter pattern at 45° angle to downwind leg, abeam midpoint of runway at 1000 ft AGL (normally)

3.3.2 Fly downwind leg, maintaining altitude within 100 ft and airspeed within 10 kts
- 3.3.2.1 Fly parallel to runway between 1/2 to 1 mile from runway
- 3.3.2.2 Use shallow "S" turns if necessary to maintain spacing with other aircraft
- 3.3.2.3 Begin descent when airplane is abeam touchdown point

3.3.3 Fly base leg, maintaining airspeed within 10 kts
- 3.3.3.1 Turn onto base leg when touchdown point is approximately 45° behind inside wingtip
- 3.3.3.2 Adjust base leg according to other traffic and wind conditions
- 3.3.3.3 Roll out on final approach at a distance no closer than 1/4 m from end of runway at altitude appropriate to glide path being flown

Input Requirements:

- pitch, bank, and yaw attitude
- rate of change of pitch, bank, and yaw
- altitude
- heading
- airspeed
- power setting
- position in relation to runway
- advisory frequency information

Output Requirements:

- rate of change of pitch, bank, and yaw
- engine power output

Training Considerations

ATC and advisory frequency communications can be simulated by the instructor. The need to fly parallel to the runway requires a side, out-the-window view. A standard, left-hand traffic pattern requires a left side view. The system should provide feedback regarding maintaining a heading appropriate to the particular traffic pattern leg being flown, altitude within 100 ft, and airspeed within 10 kts.

Device Qualification Guidelines

Baseline qualification guidelines (see p. 5)

Displays:
The PCATD should have a 90° to the left, out-the-window display, representing at least a 45° horizontal field of view, and a 30° vertical field of view.
Out-the-window view should be capable of showing runway features and markings.

Flight Dynamics:
The presence and amount of wind are reflected in the handling and performance qualities of the simulated aircraft and are consistent with a single-engine, fixed gear, basic training aircraft with a fixed-pitch propeller.

Instructional Management:
Instructor can control the amount of wind encountered during the performance of the task both before the session begins and during the session.

Authorization: Private Pilot Certificate
Task Set: 3.0 Airport Operations
Task: 3.4 Runway marking and lighting

Learning Objectives

The learning objective of this task is to acquire the knowledge of elements related to airport and runway markings and lighting.

Input Requirements:

- airport and runway marking and lighting information

Output Requirements:

- demonstration of understanding of airport and runway marking and lighting

Training Considerations

The demonstration of an understanding of airport and runway marking and lighting can be accomplished using the PCATD by having the system elicit information from the trainee through multiple choice questions, filling in blanks, etc. At a minimum, the system should provide feedback to the student regarding areas in need of review. In addition, a demonstration of understanding can be accomplished during simulation of taxiing and flight.

Device Qualification Guidelines

Displays:
The PCATD can display all airport and runway marking and lighting information.

Instructional Management:
The PCATD can test knowledge of airport and runway marking and lighting through multiple choice questions, fill-in-the blanks, etc. and provide feedback on areas of knowledge that are lacking.

Table 5. Private Pilot Certificate Task Analysis: Basic Visual Flight Maneuvers

Authorization: Private Pilot Certificate
Task Set: 4.0 Basic Visual Flight Maneuvers
Task: 4.1 Straight-and-level flight

Learning Objectives

4.1.1 Alternate scan between out-the-window view and each primary flight instrument in the order and at a sampling rate determined by mission segment

4.1.2 Maintain altitude within 100 ft.
- 4.1.2.1 Monitor relation of aircraft nose to horizon
- 4.1.2.2 Monitor attitude indicator, altimeter, vertical speed indicator, and airspeed indicator
- 4.1.2.3 Use half-bar-width correction in attitude indicator for altitude errors of less than 100 ft
- 4.1.2.4 Use full-bar-width correction in attitude indicator for altitude errors of 100 ft or more
- 4.1.2.5 During corrections in altitude, maintain a vertical speed approximately double the error in altitude but never exceeding optimum rate of climb or descent for a given airspeed and configuration
- 4.1.2.6 Recall lag characteristics of vertical speed indicator when monitoring instrument

4.1.3 Maintain heading within 10°
- 4.1.3.1 Select 2 or more outside visual reference points directly ahead of airplane and maintain airplane nose along imaginary line connecting those points
- 4.1.3.2 Monitor attitude indicator, heading indicator, and turn coordinator
- 4.1.3.3 Make correction for heading errors by using a shallow (less than 10°) angle of bank

4.1.4 Maintain airspeed within 10 kts.
- 4.1.4.1 Monitor airspeed indicator, attitude indicator, altimeter, and engine power output indicator (manifold pressure gauge or tachometer)
- 4.1.4.2 Determine need for a change in pitch and/or power based on relationship between altitude and airspeed
- 4.1.4.3 Make initial power changes greater than desired setting to accelerate rate of airspeed change, except for small speed changes
- 4.1.4.4 Apply aileron and rudder pressures when increasing power to counteract left yaw and roll tendencies

4.1.5 Make small adjustments in controls with light control pressures to correct for deviations in attitude.
- 4.1.5.1 Make adjustments in controls to stop movement of instrument indications
- 4.1.5.2 Make adjustments in controls to return to desired altitude, heading, or airspeed

4.1.6 Trim airplane so it will fly straight-and-level without assistance

Input Requirements:

- pitch, bank, and yaw attitude
- rate of change of pitch, bank, and yaw
- altitude
- heading
- airspeed
- power setting
- pitch trim setting
- relative position of nose of aircraft to horizon
- relative position of nose of aircraft to selected visual reference points

Output Requirements:

- rate of change of pitch, bank, and yaw
- engine power output
- pitch trim

Training Considerations

The user should be able to configure the system such that training on the task can begin with the aircraft positioned in the air, at a reasonable altitude for maneuvering, in straight-and-level flight, at a specified cruising speed. The system should provide feedback regarding the maintenance of heading within 10°, airspeed within 10 kts, and altitude within 100 ft.

Device Qualification Guidelines

Baseline qualification guidelines (see p. 5)

Authorization: Private Pilot Certificate

Task Set: 4.0 Basic Visual Flight Maneuvers
Task: 4.2 Airspeed transition

Learning Objectives

4.2.1 Maintain straight-and-level flight

4.2.2 Transition from cruise airspeed to slow flight
- 4.2.2.1 Set approximate pitch and power for required change in airspeed in a smooth and timely manner
- 4.2.2.2 Set flaps to stage 1 (depending on training goal)
- 4.2.2.3 Make proper use of trim control
- 4.2.2.4 Scan continuously without excessive fixation or omission
- 4.2.2.5 Make small adjustments in controls to correct for deviations in airspeed and heading

4.2.3 Transition from slow flight to cruise airspeed
- 4.2.3.1 Set approximate pitch and power for required change in airspeed in a smooth and timely manner
- 4.2.3.2 Set flaps to full up
- 4.2.3.3 Make proper use of trim control
- 4.2.3.4 Scan continuously without excessive fixation or omission
- 4.2.3.5 Make small adjustments in controls to correct for deviations in airspeed and heading

Input Requirements:

- pitch, bank, and yaw attitude
- rate of change of pitch, bank, and yaw
- altitude
- heading
- airspeed
- power setting
- pitch trim setting
- flaps setting
- relative position of nose of aircraft to horizon
- relative position of nose of aircraft to selected visual reference points

Output Requirements:

- rate of change of pitch, bank, and yaw
- engine power output
- pitch trim
- flaps setting

Training Considerations

The user should be able to configure the system such that training on the task can begin with the aircraft positioned in the air, at a reasonable altitude for maneuvering, in straight-and-level flight, at a specified cruising speed. The system should provide feedback regarding the maintenance of heading within 10°, airspeed within 10 kts, and altitude within 100 ft.

Device Qualification Guidelines

Baseline qualification guidelines (see p. 5)

Authorization: Private Pilot Certificate
Task Set: 4.0 Basic Visual Flight Maneuvers
Task: 4.3 Constant airspeed climb

Learning Objectives

4.3.1 Maintain straight-and-level flight

4.3.2 Transition from staight-and-level flight to a constant airspeed climb configuration
- 4.3.2.1 Set full power and approximate pitch for required climb speed in a smooth and timely manner
- 4.3.2.2 Make proper use of trim control
- 4.3.2.3 Scan continuously without excessive fixation or omission
- 4.3.2.4 Make small adjustments in controls to correct for deviations in climb speed and heading

4.3.3 Transition from a constant airspeed climb to straight-and-level flight at desired altitude
- 4.3.3.1 Begin level off at appropriate point prior to reaching desired altitude (10% rule)
- 4.3.3.2 Set approximate pitch and power for straight-and-level flight
- 4.3.3.3 Make proper use of trim control
- 4.3.3.4 Scan continuously without excessive fixation or omission
- 4.3.3.5 Make small adjustments in controls to correct for deviations in attitude

Input Requirements:

- pitch, bank, and yaw attitude
- rate of change of pitch, bank, and yaw
- altitude
- heading
- airspeed
- power setting
- pitch trim setting
- relative position of nose of aircraft to horizon
- relative position of nose of aircraft to selected visual reference points

Output Requirements:

- rate of change of pitch, bank, and yaw
- engine power output
- pitch trim

Training Considerations

The user should be able to configure the system such that training on the task can begin with the aircraft positioned in the air, at a reasonable altitude for maneuvering, in straight-and-level flight, at a specified cruising speed. The system should provide feedback regarding the maintenance of heading within 10°, airspeed within 10 kts, and altitude within 100 ft. In addition, since the trainee is transitioning from one altitude to another, feedback should be provided both in maintaining the initial altitude, and in achieving and maintaining the second altitude.

Device Qualification Guidelines

Baseline qualification guidelines (see p. 5)

Authorization: Private Pilot Certificate
Task Set: 4.0 Basic Visual Flight Maneuvers
Task: 4.4 Constant airspeed descent

Learning Objectives

4.4.1 Maintain straight-and-level flight

4.4.2 Transition from staight-and-level flight to a constant airspeed descent configuration
- 4.4.2.1 Set approximate pitch and power for required descent speed in a smooth and timely manner
- 4.4.2.2 Set flaps to stage 1 (depending on training goal)
- 4.4.2.3 Make proper use of trim control
- 4.4.2.4 Scan continuously without excessive fixation or omission
- 4.4.2.5 Make small adjustments in controls to correct for deviations in descent speed and heading

4.4.3 Transition from a constant airspeed descent to straight-and-level flight at desired altitude
- 4.4.3.1 Begin level off at appropriate point prior to reaching desired altitude (10% rule)
- 4.4.3.2 Set flaps to full up
- 4.4.3.3 Set approximate pitch and power for straight-and-level flight
- 4.4.3.4 Make proper use of trim control
- 4.4.3.5 Scan continuously without excessive fixation or omission
- 4.4.3.6 Make small adjustments in controls to correct for deviations in attitude

Input Requirements:

- pitch, bank, and yaw attitude
- rate of change of pitch, bank, and yaw
- altitude
- heading
- airspeed
- power setting
- pitch trim setting
- flaps setting
- relative position of nose of aircraft to horizon
- relative position of nose of aircraft to selected visual reference points

Output Requirements:

- rate of change of pitch, bank, and yaw
- engine power output
- pitch trim
- flaps setting

Training Considerations

The user should be able to configure the system such that training on the task can begin with the aircraft positioned in the air, at a reasonable altitude for maneuvering, in straight-and-level flight, at a specified cruising speed. The system should provide feedback regarding the maintenance of heading within 10°, airspeed within 10 kts, and altitude within 100 ft. In addition, since the trainee is transitioning from one altitude to another, feedback should be provided both in maintaining the initial altitude, and in achieving and maintaining the second altitude.

Device Qualification Guidelines

Baseline qualification guidelines (see p. 5)

Authorization: Private Pilot Certificate
Task Set: 4.0 Basic Visual Flight Maneuvers
Task: 4.5 Level turns

Learning Objectives

4.5.1 Maintain straight-and-level flight

4.5.2 Transition from straight-and-level flight to level turning flight
- 4.5.2.1 Apply coordinated aileron and rudder pressures in desired direction of turn
- 4.5.2.2 Roll into turn at a rate based on scan rate (Nothing is gained by maneuvering an airplane faster than your capacity to keep up with changes)
- 4.5.2.3 Use attitude indicator and aircraft reference to establish approximate angle of bank needed
- 4.5.2.4 Use altimeter, outside aircraft reference, and attitude indicator for pitch adjustments necessary as vertical lift component decreases with an increase in bank
- 4.5.2.5 Use airspeed indicator to maintain constant airspeed
- 4.5.2.6 Scan continuously without excessive fixation or omission

4.5.3 Maintain turn
- 4.5.3.1 Use external aircraft reference to maintain bank attitude
- 4.5.3.2 Use turn coordinator for controlling yaw (step on the ball)
- 4.5.3.3 Make proper use of trim control
- 4.5.3.4 Scan continuously without excessive fixation or omission
- 4.5.3.5 Make small adjustments in controls to correct for deviations in altitude, bank angle, yaw (yoke and rudder pedals) and airspeed (throttle)

4.5.4 Transition from turning to straight-and-level flight at desired heading
- 4.5.4.1 Roll out of turn beginning at a point before desired heading approximately equal to half your angle of bank
- 4.5.4.2 Apply coordinated aileron and rudder pressures opposite the direction of turn
- 4.5.4.3 Roll out of turn at same rate as was used to roll in to turn
- 4.5.4.4 Use heading indicator and aircraft reference for bank attitude control, as in straight-and-level flight
- 4.5.4.5 Scan continuously without excessive fixation or omission
- 4.5.4.6 Make pitch, power, and trim adjustments as changes in vertical lift component and airspeed occur

4.5.5 Maintain straight-and-level flight

Input Requirements:

- pitch, bank, and yaw attitude
- rate of change of pitch, bank, and yaw
- altitude
- heading
- airspeed
- power setting
- pitch trim setting
- relative position of nose of aircraft to horizon
- relative position of nose of aircraft to selected visual reference points

Output Requirements:

- rate of change of pitch, bank, and yaw
- engine power output
- pitch trim

Training Considerations

The user should be able to configure the system such that training on the task can begin with the aircraft positioned in the air, at a reasonable altitude for maneuvering, in straight-and-level flight, at a specified cruising speed. The system should provide feedback regarding the maintenance of heading within 10°, airspeed within 10 kts, bank within 5° and

altitude within 100 ft. In addition, since the trainee is transitioning from one heading to another, feedback should be provided both in maintaining the initial heading, and in achieving and maintaining the second heading. The trainee should receive practice at turning both left and right through various degrees of heading changes and at various angles of bank.

Device Qualification Guidelines

Baseline qualification guidelines (see p. 5)

Authorization: Private Pilot Certificate
Task Set: 4.0 Basic Visual Flight Maneuvers
Task: 4.6 Climbing turn

Learning Objectives

Climbing turns combine the techniques used in straight climbs and level turns (see Tasks 4.3 and 4.5). The aerodynamic factors affecting lift and power control must be considered in determining power settings, and the rate of cross-check and interpretation must be increased to enable control of bank as well as pitch changes.

Input Requirements:

- pitch, bank, and yaw attitude
- rate of change of pitch, bank, and yaw
- altitude
- heading
- airspeed
- power setting
- pitch trim setting
- relative position of nose of aircraft to horizon
- relative position of nose of aircraft to selected visual reference points

Output Requirements:

- rate of change of pitch, bank, and yaw
- engine power output
- pitch trim

Training Considerations

The user should be able to configure the system such that training on the task can begin with the aircraft positioned in the air, at a reasonable altitude for maneuvering, in straight-and-level flight, at a specified cruising speed. The system should provide feedback regarding the maintenance of heading within 10°, airspeed within 10 kts, bank within 5° and altitude within 100 ft. In addition, since the trainee is transitioning from one heading to another, and from one altitude to another, feedback should be provided both in maintaining the initial heading and altitude, and in achieving and maintaining the second heading and altitude. The trainee should receive practice at turning both left and right through various degrees of heading and altitude changes.

Device Qualification Guidelines

Baseline qualification guidelines (see p. 5)

Authorization: Private Pilot Certificate
Task Set: 4.0 Basic Visual Flight Maneuvers
Task: 4.7 Descending turn

Learning Objectives

Descending turns combine the techniques used in straight descents and level turns (see Tasks 4.4 and 4.5). The aerodynamic factors affecting lift and power control must be considered in determining power settings, and the rate of cross-check and interpretation must be increased to enable control of bank as well as pitch changes.

Input Requirements:

- pitch, bank, and yaw attitude
- rate of change of pitch, bank, and yaw
- altitude
- heading
- airspeed
- power setting
- pitch trim setting
- relative position of nose of aircraft to horizon
- relative position of nose of aircraft to selected visual reference points

Output Requirements:

- rate of change of pitch, bank, and yaw
- engine power output
- pitch trim

Training Considerations

The user should be able to begin the task with the aircraft positioned in the air, at a reasonable altitude for maneuvering, in straight-and-level flight, at a specified cruising speed. The system should provide feedback regarding the maintenance of heading within 10°, airspeed within 10 kts, bank within 5° and altitude within 100 ft. In addition, since the trainee is transitioning from one heading to another and from one altitude to another, feedback should be provided both in maintaining the initial heading and altitude, and in achieving and maintaining the second heading and altitude. The trainee should receive practice at turning both left and right through various degrees of heading and altitude changes.

Device Qualification Guidelines

Baseline qualification guidelines (see p. 5)

Authorization: Private Pilot Certificate
Task Set: 4.0 Basic Visual Flight Maneuvers
Task: 4.8 Steep turns

Learning Objectives

4.8.1 Maintain straight-and-level flight

4.8.2 Transition from straight-and-level flight to level steep turn

- 4.8.2.1 Add power (usually to around 2400 RPM)
- 4.8.2.2 Apply coordinated aileron and rudder pressures in desired direction of turn
- 4.8.2.3 Roll into turn at a rate based on scan rate (Nothing is gained by maneuvering an airplane faster than your capacity to keep up with changes)
- 4.8.2.4 Use attitude indicator and aircraft reference to establish approximate angle of bank needed (approxi mately 45°)
- 4.8.2.5 After bank angle exceeds 30°, begin putting back pressure on column to compensate for loss of vertical lift component
- 4.8.2.6 Use altimeter, aircraft reference, and attitude indicator for pitch adjustments necessary as vertical lift component decreases with increase in bank
- 4.8.2.7 Use airspeed indicator to maintain constant airspeed
- 4.8.2.8 Scan continuously without excessive fixation or omission

4.8.3 Maintain turn
- 4.8.3.1 Use aircraft reference to control bank
- 4.8.3.2 Use turn coordinator for controlling yaw (step on ball)
- 4.8.3.3 Scan continuously without excessive fixation or omission
- 4.8.3.4 Make small adjustments in controls to correct for deviations in altitude, bank angle, yaw (yoke and rudder pedals) and airspeed (throttle)

4.8.4 Transition from turning to straight-and-level flight at desired heading
- 4.8.4.1 Begin rolling out of turn at a point before reaching desired heading approximately equal to half your angle of bank
- 4.8.4.2 Apply coordinated aileron and rudder pressures opposite direction of turn
- 4.8.4.3 Roll out of turn at the same rate as was used to roll into the turn
- 4.8.4.4 Use heading indicator and aircraft reference when approximately level as in straight-and-level flight
- 4.8.4.5 Scan continuously without excessive fixation or omission
- 4.8.4.6 Make pitch, power and trim adjustments as changes in vertical lift component and airspeed occur

4.8.5 Maintain straight-and-level flight

Input Requirements:

- pitch, bank, and yaw attitude
- rate of change of pitch, bank, and yaw
- altitude
- heading
- airspeed
- power setting
- pitch trim setting
- relative position of nose of aircraft to horizon
- relative position of nose of aircraft to selected visual reference points

Output Requirements:

- rate of change of pitch, bank, and yaw
- engine power output
- pitch trim

Training Considerations

The user should be able to configure the system such that training on the task can begin with the aircraft positioned in the air, at a reasonable altitude for maneuvering, in straight-and-level flight, at a specified cruising speed. The system should provide feedback regarding the maintenance of heading within 10°, airspeed within 10 kts, bank within 5° and altitude within 100 ft. In addition, since the trainee is transitioning from one heading to another, feedback should be provided both in maintaining the initial heading, and in achieving and maintaining the second heading. Steep turns are usually 180° or 360° to the left or right, and both left and right turns should be practiced.

Device Qualification Guidelines

Baseline qualification guidelines (see p. 5)

Table 6. Private Pilot Certificate Task Analysis: Takeoffs, Landings, and Go-Arounds

Authorization: Private Pilot Certificate
Task Set: 5.0 Takeoffs, Landings, and Go-Arounds
Task: 5.1 Takeoff and climb

Learning Objectives

5.1.1 Begin takeoff roll
- 5.1.1.1 Place right hand on throttle and maintain throughout takeoff
- 5.1.1.2 Place feet on floor with balls of feet on bottom edges of rudder pedals
- 5.1.1.3 Apply power smoothly
- 5.1.1.4 Select and monitor point on cowl through which runway centerline passes to maintain directional control
- 5.1.1.5 Check engine instruments to ensure engine is developing full power and operating within limits

5.1.2 Maintain takeoff roll
- 5.1.2.1 Maintain directional control with rudder pedals
- 5.1.2.2 Position ailerons appropriately to compensate for crosswind effects
- 5.1.2.3 Alter amount of rudder and aileron deflection appropriately as speed increases

5.1.3 Establish takeoff attitude at speed specified in pilot's operating handbook

5.1.4 Establish climb attitude after accelerating to climb speed
- 5.1.4.1 Use climb speed appropriate for local conditions (crosswind, obstacle clearance, etc.)
- 5.1.4.2 Adjust pitch attitude to maintain selected climb speed
- 5.1.4.3 Enter a crab, if necessary, to allow airplane to track straight out on an imaginary extension of runway centerline
- 5.1.4.4 Maintain takeoff power to a safe maneuvering altitude

Input Requirements:

- pitch, bank, and yaw attitude
- rate of change of pitch, bank, and yaw
- altitude
- heading
- airspeed
- power setting
- relative position of nose of aircraft to horizon
- relative position of nose of aircraft to selected visual reference points
- position in relation to runway
- wind speed and direction

Output Requirements:

- rate of change of pitch, bank, and yaw
- engine power output

Training Considerations

The user should be able to begin the task with the aircraft positioned on the runway. The system should provide feedback regarding the smooth application of power, rotation at the appropriate airspeed, maintaining airspeed within 5 kts during climb, and heading within 10°. This task should be practiced initially with no crosswind component and then later under various crosswind conditions.

Device Qualification Guidelines

Baseline qualification guidelines (see p. 5)

Displays:
Out-the-window view should be capable of showing runway features and markings.

Flight Dynamics:
The presence and amount of wind are reflected in the handling and performance qualities of the simulated aircraft and are consistent with a single-engine, fixed gear, basic training aircraft with a fixed-pitch propeller.

Instructional Management:
Instructor can control the amount of wind encountered during the performance of the task both before the session begins and during the session.

Authorization: Private Pilot Certificate
Task Set: 5.0 Takeoffs, Landings, and Go-Arounds
Task: 5.2 Approach and landing

Learning Objectives

5.2.1 Fly downwind leg
- 5.2.1.1 Fly parallel to runway, approximately 1/2 to 1 mile from runway, and 1000 ft AGL
- 5.2.1.2 Transition to approach speed when directly opposite intended touchdown point (approach speed is defined in POH or is 1.3 times power-off stall speed in the landing configuration)
- 5.2.1.3 Initiate descent when approach speed is attained
- 5.2.1.4 Initiate turn to base leg when touchdown point is approximately 30° to 45° behind the wing
- 5.2.1.5 Vary start of turn to base leg to compensate for variations in wind and traffic conditions

5.2.2 Fly base leg
- 5.2.2.1 Vary heading on base leg to compensate for wind conditions
- 5.2.2.2 Monitor ground track for further adjustments in heading
- 5.2.2.3 Assess position after rolling out on base leg (key position) and determine whether or not to make correction in approach pattern
- 5.2.2.4 Extend flaps to intermediate position
- 5.2.2.5 Correct for being too high by reducing power and/or extending additional flaps
- 5.2.2.6 Correct for being too low or wide, or the wind stronger than normal, by inititating turn to final sooner than normal, and/or adding power
- 5.2.2.7 Look in all directions for other traffic before turning to final approach

5.2.3 Fly final approach leg
- 5.2.3.1 Roll out on final approach leg at least one-quarter mile from runway threshold, approximately 300 to 400 ft AGL, on an imaginary extension of runway centerline
- 5.2.3.2 Maintain approach speed as specified in POH or 1.3 $V_{S0,}$ as appropriate (do not adjust approach speed for nonstandard temperature or pressure)
- 5.2.3.3 Extend flaps to full position
- 5.2.3.4 Use visual attitude references to control speed
- 5.2.3.5 Adjust rate of descent depending on headwind component
- 5.2.3.6 Maintain constant approach angle to runway by maintaining a constant apparent width and length of the runway throughout the approach

5.2.4 Land airplane
- 5.2.4.1 Estimate point at which the airplane will touch down by finding the point where the glide path inter sects the ground and adding distance to be traveled in the flare

5.2.4.2 Initiate flare with gradual increase in back pressure on control wheel when approximately 10 to 20 ft above the ground (use visual cues to determine height above runway and rate of descent)

5.2.4.3 Focus about same distance ahead of the airplane as when driving a car at same speed

5.2.4.4 Increase back pressure until approximately 1 ft above runway, with a rate of descent near zero, at about 8 to 10 kts above stall speed with idle power

5.2.4.5 Allow airplane to slowly settle to runway in a slightly nose-high attitude as it approaches stall speed (pitch attitude at touchdown should be very close to pitch attitude at takeoff)

5.2.4.6 Maintain back pressure after touchdown to allow nosewheel to touch down gently

5.2.4.7 Maintain directional control during roll-out with rudder pressure, having feet in same position on rudder pedals as during flare (heels on floor)

Input Requirements:

- pitch, bank, and yaw attitude
- rate of change of pitch, bank, and yaw
- altitude
- heading
- airspeed
- power setting
- flaps setting
- relative position of nose of aircraft to horizon
- relative position of nose of aircraft to selected visual reference points
- position in relation to runway
- wind speed and direction

Output Requirements:

- rate of change of pitch, bank, and yaw
- engine power output
- flaps setting

Training Considerations

The user should be able to begin the task with the aircraft positioned in the air, at a point along the downwind leg, at a reasonable altitude for maneuvering, in straight-and-level flight, at a specified cruising speed. The system should provide feedback regarding the maintenance of heading within 10°, airspeed within 10 kts, bank within 5° and altitude within 100 ft. The system should provide the trainee with specific altitude feedback during the entire performance of the task, including the point of touchdown. Out-the-window visual requirements for this task are more critical than for most other tasks since the trainee must acquire a sense of altitude within a few feet, and speed within a few knots, based on visual cues. Training must occur in both crosswind and no crosswind conditions and with various wind speeds. The system must provide some positive indication of touchdown to the trainee. Since kinesthetic cues are unavailable, the sound of tires on a surface is the most likely candidate. It is unlikely that any reasonably priced system will provide the visual, auditory, and kinesthetic cues necessary for adequate simulation of this task, especially actual touchdown and roll out. Most PC-based systems are not capable of simulating one wheel touching the runway while the other is still in the air, as is done for crosswind landings. Even if the flight dynamics could be simulated, the trainee would not have good enough visual or kinesthetic information available to distinguish the relationship of the aircraft to the runway. Therefore, the required device characteristics for this task to be specified will assume that task training will only involve the approach portion of the task, not the actual landing. However, it should be noted that research has indicated that the use of a PCATD has resulted in significant reductions in the number of landings required prior to conducting the first solo flight (Koonce, Moore, & Benton, 1995).

Device Qualification Guidelines

Baseline qualification guidelines (see p. 5)

Displays:

The PCATD should have a 90° to the left, out-the-window display, representing at least a 45° horizontal field of view, and a 30° vertical field of view.

Out-the-window view should be capable of showing runway features and markings.
The PCATD provides an auditory signal to indicate contact between wheels and runway surface.

Flight Dynamics:
The presence and amount of wind are reflected in the handling and performance qualities of the simulated aircraft and are consistent with a single-engine, fixed gear, basic training aircraft with a fixed-pitch propeller.

Instructional Management:
Instructor can control the amount of wind encountered during the performance of the task both before the session begins and during the session.

Authorization: Private Pilot Certificate
Task Set: 5.0 Takeoffs, Landings, and Go-Arounds
Task: 5.3 Go-arounds

Learning Objectives

5.3.1 Decide to discontinue approach to landing and execute a go-around

5.3.2 Apply takeoff power

5.3.3 Alter pitch attitude to slow or stop descent

5.3.4 Retract flaps partially (in takeoff position if recommended by manufacturer)

5.3.5 Maintain appropriate pressure on controls for straight flight and a safe climb attitude
- 5.3.5.1 Apply firm forward yoke pressure
- 5.3.5.2 Apply right rudder pressure to counteract torque, or P-factor
- 5.3.5.3 Retrim airplane to relieve heavy control pressures

5.3.6 Allow aircraft to accelerate to best-rate-of-climb speed

5.3.7 Retract flaps to full up position

5.3.8 Proceed as in normal climb after takeoff

Input Requirements:

- pitch, bank, and yaw attitude
- rate of change of pitch, bank, and yaw
- altitude
- heading
- airspeed
- power setting
- flaps setting
- trim setting
- relative position of nose of aircraft to horizon
- relative position of nose of aircraft to selected visual reference points
- position in relation to runway
- wind speed and direction

Output Requirements:

- rate of change of pitch, bank, and yaw
- engine power output
- flaps setting
- trim setting

Training Considerations

The user should be able to begin the task with the aircraft positioned in the air, at a point along the final approach, in descending flight, at a specified approach speed. The system should provide feedback regarding the maintenance of heading within 10°, airspeed within 10 kts, bank within 5° and altitude within 100 ft. In addition, the system should provide feedback regarding the proper sequence for adding power, establishing a proper aircraft attitude, and retracting the flaps. Go-arounds should be practiced in both wind and no-wind conditions, beginning in no-wind conditions.

Device Qualification Guidelines

Baseline qualification guidelines (see p. 5)

Displays:
Out-the-window view should be capable of showing runway features and markings.

Flight Dynamics:
The presence and amount of wind are reflected in the handling and performance qualities of the simulated aircraft and are consistent with a single-engine, fixed gear, basic training aircraft with a fixed-pitch propeller.

Instructional Management:
Instructor can control the amount of wind encountered during the performance of the task both before the session begins and during the session.

Authorization: Private Pilot Certificate
Task Set: 5.0 Takeoffs, Landings, and Go-Arounds
Task: 5.4 Forward slips to a landing

Learning Objectives

5.4.1 Consider wind conditions, landing surface, and obstructions to select most suitable touchdown point

5.4.2 Establish slipping attitude
- 5.4.2.1 Set engine power to idle
- 5.4.2.2 Lower forward wing using ailerons
- 5.4.2.3 Apply opposite rudder sufficient to maintain original ground track
- 5.4.2.4 Raise nose of aircraft to prevent increase in airspeed

5.4.3 Maintain ground track aligned with runway centerline

5.4.4 Maintain airspeed resulting in minimum float during roundout

5.4.5 Realign airplane with runway just prior to touchdown

5.4.6 Maintain crosswind correction and directional control throughout the approach and landing

Input Requirements:

- pitch, bank, and yaw attitude
- rate of change of pitch, bank, and yaw
- altitude
- heading
- airspeed
- power setting
- flaps setting
- relative position of nose of aircraft to horizon

- relative position of nose of aircraft to selected visual reference points
- position in relation to runway
- wind speed and direction

Output Requirements:

- rate of change of pitch, bank, and yaw
- engine power output
- flaps setting

Training Considerations

The user should be able to begin the task with the aircraft positioned in the air, at a point along the final approach, in descending flight, at a specified approach speed. The system should provide feedback regarding the maintenance of ground track, airspeed within 10 kts, and point of touchdown within 400 ft. Forward slips should be practiced in both wind and no-wind conditions.

Device Qualification Guidelines

Baseline qualification guidelines (see p. 5)

Displays:
Out-the-window view should be capable of showing runway features and markings.

Flight Dynamics:
The presence and amount of wind are reflected in the handling and performance qualities of the simulated aircraft and are consistent with a single-engine, fixed gear, basic training aircraft with a fixed-pitch propeller.

Instructional Management:
Instructor can control the amount of wind encountered during the performance of the task both before the session begins and during the session.

Authorization: Private Pilot Certificate
Task Set: 5.0 Takeoffs, Landings, and Go-Arounds
Task: 5.5 Short-field takeoff and climb

Learning Objectives

5.5.1 Position aircraft at runway threshold, aligned with intended takeoff path

5.5.2 Extend flaps to position recommended by airplane manufacturer

5.5.3 Apply maximum allowable power smoothly and efficiently while simultaneously releasing brakes

5.5.4 Apply back pressure on elevator control when best angle-of-climb speed (Vx) is attained

5.5.5 Apply additional back pressure after lift off as necessary to hold a constant airspeed

5.5.6 Maintain straight climb at Vx until obstacles have been cleared or, if no obstacles are involved, until an altitude of at least 50 ft above takeoff surface is attained

5.5.7 Lower pitch attitude to achieve best rate-of-climb speed (Vy) until a safe maneuvering altitude is attained

5.5.8 Retract flaps in increments after achieving Vy until flaps are fully retracted

Input Requirements:

- pitch, bank, and yaw attitude
- rate of change of pitch, bank, and yaw
- altitude
- heading
- airspeed
- power setting
- flaps setting
- relative position of nose of aircraft to horizon
- relative position of nose of aircraft to selected visual reference points
- position in relation to runway
- wind speed and direction

Output Requirements:

- rate of change of pitch, bank, and yaw
- engine power output
- flaps setting

Training Considerations

The user should be able to begin the task with the aircraft positioned at the runway threshold. The system should provide feedback regarding the smooth application of power, rotation at the appropriate airspeed, maintaining airspeed within 5 kts during climb, and heading within 10°, and appropriate retraction of flaps. This task should be practiced initially with no crosswind component and then later under various crosswind conditions

Device Qualification Guidelines

Baseline qualification guidelines (see p. 5)

Displays:
Out-the-window view should be capable of showing runway features and markings.

Flight Dynamics:
The presence and amount of wind are reflected in the handling and performance qualities of the simulated aircraft and are consistent with a single-engine, fixed gear, basic training aircraft with a fixed-pitch propeller.

Instructional Management:
Instructor can control the amount of wind encountered during the performance of the task both before the session begins and during the session.

Authorization: Private Pilot Certificate
Task Set: 5.0 Takeoffs, Landings, and Go-Arounds
Task: 5.6 Soft-field takeoff and climb

Learning Objectives

5.6.1 Extend flaps to position recommended by airplane manufacturer

5.6.2 Taxi aircraft onto runway without stopping

5.6.3 Apply maximum allowable power smoothly and efficiently when aligned with proposed takeoff path

5.6.4 Apply back pressure on elevator control while accelerating to establish positive angle of attack and reduce weight supported by nosewheel

5.6.5 Reduce back pressure immediately after becoming airborne to allow airplane to accelerate to Vy or Vx (ground effect will cause the airplane to become airborne before appropriate speeds are attained)

5.6.6 Retract flaps in increments after achieving Vy until flaps are fully retracted

5.6.7 Reduce power to normal climb setting

5.6.8 Maintain directional control and proper wind-drift correction throughout takeoff and climb

Input Requirements:

- pitch, bank, and yaw attitude
- rate of change of pitch, bank, and yaw
- altitude
- heading
- airspeed
- power setting
- flaps setting
- relative position of nose of aircraft to horizon
- relative position of nose of aircraft to selected visual reference points
- position in relation to takeoff surface
- wind speed and direction

Output Requirements:

- rate of change of pitch, bank, and yaw
- engine power output
- flaps setting

Training Considerations

In addition to the normal cues regarding position relative to the ground, this task requires that there be explicit and immediate feedback given regarding when the aircraft becomes airborne. The trainee must learn to maneuver the airplane in such a manner so that it does not lose ground effect while accelerating to an appropriate climb speed. The user should be able to begin the task with the aircraft positioned on the ground, near the takeoff surface. The system should provide feedback regarding the smooth application of power, rotation at the appropriate airspeed, maintaining airspeed within 5 kts during climb, and heading within 10°, and appropriate retraction of flaps. This task should be practiced initially with no crosswind component and then later under various crosswind conditions

Device Qualification Guidelines

Baseline qualification guidelines (see p. 5)

Displays:
Out-the-window view should be capable of showing runway features and markings.

Flight Dynamics:
The presence and amount of wind are reflected in the handling and performance qualities of the simulated aircraft and are consistent with a single-engine, fixed gear, basic training aircraft with a fixed-pitch propeller.

Instructional Management:
Instructor can control the amount of wind encountered during the performance of the task both before the session begins and during the session.

Authorization: Private Pilot Certificate
Task Set: 5.0 Takeoffs, Landings, and Go-Arounds
Task: 5.7 Short-field approach and landing

Learning Objectives

5.7.1 Extend flaps to position recommended by airplane manufacturer (usually full flaps)

5.7.2 Fly final approach leg
- 5.7.2.1 Roll out on final approach leg at least one-quarter mile from runway threshold, approximately 500 ft AGL, on an imaginary extension of the runway centerline
- 5.7.2.2 Maintain approach speed as specified in POH or 1.3 $V_{S0,}$ as appropriate (do not adjust approach speed for nonstandard temperature or pressure)
- 5.7.2.3 Adjust pitch attitude as necessary to establish and maintain desired rate or angle of descent
- 5.7.2.4 Adjust power to maintain desired airspeed
- 5.7.2.5 Adjust rate of descent depending on headwind component
- 5.7.2.6 Maintain constant approach angle to runway by maintaining a constant apparent width and length of the runway throughout the approach

5.7.3 Land airplane
- 5.7.3.1 Estimate point at which airplane will touch down by finding point where glide path intersects the ground and adding distance to be traveled in the flare
- 5.7.3.2 Initiate flare with gradual increase in back pressure on control wheel when approximately 10 to 20 ft above ground (use visual cues to determine height above runway and rate of descent)
- 5.7.3.3 Focus about same distance ahead of airplane as when driving a car at same speed
- 5.7.3.4 Increase back pressure until approximately 1 ft above runway, with a rate of descent near zero, as close to stall speed as possible with idle power
- 5.7.3.5 Allow airplane to slowly settle to runway in a slightly nose-high attitude as it approaches stall speed (pitch attitude at touchdown should be very close to pitch attitude at takeoff)
- 5.7.3.6 Maintain back pressure after touchdown to allow nosewheel to touch down gently
- 5.7.3.7 Apply brakes evenly and firmly immediately upon touchdown and after closing throttle to minimize after-landing roll
- 5.7.3.8 Maintain directional control during roll-out with brake pressure

Input Requirements:

- pitch, bank, and yaw attitude
- rate of change of pitch, bank, and yaw
- altitude
- heading
- airspeed
- power setting
- flaps setting
- relative position of nose of aircraft to horizon
- relative position of nose of aircraft to selected visual reference points
- position in relation to runway
- wind speed and direction

Output Requirements:

- rate of change of pitch, bank, and yaw
- engine power output
- flaps setting

Training Considerations

The user should be able to begin the task with the aircraft positioned in the air, at a point along the base leg, at a reasonable altitude for maneuvering, in straight-and-level flight, at a specified cruising speed. The system should provide feedback regarding the maintenance of heading within 10°, airspeed within 10 kts, bank within 5°, and altitude within 100 ft. The system should provide the trainee with specific altitude feedback during the entire performance of the task, including the point of touchdown. Out-the-window visual requirements for this task are more critical than for most other tasks since the trainee must acquire a sense of altitude within a few feet, and speed within a few knots, based on visual cues. Training must occur in both crosswind and no crosswind conditions and with various wind speeds. The system must provide some positive indication of touchdown to the trainee. Since kinesthetic cues are unavailable, the sound of tires on a surface is the most likely candidate. It is unlikely that any reasonably priced system will provide the visual, auditory, and kinesthetic cues necessary for adequate simulation of this task, especially actual touchdown and roll out. Most PC-based systems are not capable of simulating one wheel touching the runway while the other is still in the air, as is done for crosswind landings. Even if the flight dynamics could be simulated, the trainee would not have good enough visual or kinesthetic information available to distinguish the relationship of the aircraft to the runway. Therefore, the required device characteristics for this task to be specified will assume that task training will only involve the approach portion of the task, not the actual landing.

Device Qualification Guidelines

Baseline qualification guidelines (see p. 5)

Displays:
The PCATD should have a 90° to the left, out-the-window display, representing at least a 45° horizontal field of view, and a 30° vertical field of view.
Out-the-window view should be capable of showing runway features and markings.
The PCATD provides an auditory signal to indicate contact between wheels and runway surface.

Flight Dynamics:
The presence and amount of wind are reflected in the handling and performance qualities of the simulated aircraft and are consistent with a single-engine, fixed gear, basic training aircraft with a fixed-pitch propeller.

Instructional Management:
Instructor can control the amount of wind encountered during the performance of the task both before the session begins and during the session.

Authorization: Private Pilot Certificate
Task Set: 5.0 Takeoffs, Landings, and Go-Arounds
Task: 5.8 Soft-field approach and landing

Learning Objectives

The approach portion of this task is exactly the same as for normal approaches (Task 5.2) or short-field approaches (Task 5.7) depending on the length of the landing area and the kinds of obstacles that must be cleared. The actual flare, touchdown, and roll out portion of the task cannot be simulated appropriately for learning transfer to occur.

Input Requirements:

- pitch, bank, and yaw attitude
- rate of change of pitch, bank, and yaw
- altitude
- heading
- airspeed
- power setting
- flaps setting

- relative position of nose of aircraft to horizon
- relative position of nose of aircraft to selected visual reference points
- position in relation to runway
- wind speed and direction

Output Requirements:

- rate of change of pitch, bank, and yaw
- engine power output
- flaps setting

Training Considerations

The user should be able to begin the task with the aircraft positioned in the air, at a point along the base leg, at a reasonable altitude for maneuvering, in straight-and-level flight, at a specified cruising speed. The system should provide feedback regarding the maintenance of heading within 10°, airspeed within 10 kts, bank within 5° and altitude within 100 ft. The system should provide the trainee with specific altitude feedback during the entire performance of the task, including the point of touchdown. Out-the-window visual requirements for this task are more critical than for most other tasks since the trainee must acquire a sense of altitude within a few feet, and speed within a few knots, based on visual cues. Training must occur in both crosswind and no crosswind conditions and with various wind speeds. It is unlikely that any reasonably priced system will provide the visual, auditory, and kinesthetic cues necessary for adequate simulation of this task, especially flare, touchdown, and roll out. Most PC-based systems are not capable of simulating one wheel touching the landing surface while the other is still in the air, as is done for crosswind landings. Even if the flight dynamics could be simulated, the trainee would not have sufficient visual or kinesthetic information to distinguish the relationship of the aircraft to the landing surface. Therefore, the required device characteristics for this task will assume that task training will only involve the approach portion of the task, not the actual landing.

Device Qualification Guidelines

Baseline qualification guidelines (see p. 5)

Displays:

The PCATD should have a 90° to the left, out-the-window display, representing at least a 45° horizontal field of view, and a 30° vertical field of view.

Out-the-window view should be capable of showing runway features and markings.

The PCATD provides auditory signal to indicate contact between wheels and runway surface.

Flight Dynamics:

The presence and amount of wind are reflected in the handling and performance qualities of the simulated aircraft and are consistent with a single-engine, fixed gear, basic training aircraft with a fixed-pitch propeller.

Instructional Management:

Instructor can control the amount of wind encountered during the performance of the task both before the session begins and during the session.

Table 7. Private Pilot Certificate Task Analysis: Ground Reference Maneuvers

Authorization: Private Pilot Certificate
Task Set: 6.0 Ground Reference Maneuvers
Task: 6.1 Rectangular courses

Learning Objectives

6.1.1 Fly upwind leg
- 6.1.1.1 Maintain straight-and-level flight using out-the-window visual references
- 6.1.1.2 Turn onto next leg using a level, slow, shallow turn initially, increasing bank angle and rate of turn as headwind component decreases
- 6.1.1.3 Turn out on crosswind leg with enough crab angle to compensate for crosswind component

6.1.2 Fly crosswind leg
- 6.1.2.1 Maintain straight-and-level flight using out-the-window visual references
- 6.1.2.2 Adjust crab angle as necessary to maintain course
- 6.1.2.3 Turn onto downwind leg using a level, medium bank, increasing bank angle and rate of turn as tailwind component increases

6.1.3 Fly downwind leg
- 6.1.3.1 Maintain straight-and-level flight using out-the-window visual references
- 6.1.3.2 Adjust crab angle as necessary to maintain course
- 6.1.3.3 Turn onto crosswind leg using a level, fast rate of roll-in with relatively steep bank, gradually reducing bank angle as tailwind component decreases

6.1.4 Fly crosswind leg
- 6.1.4.1 Maintain straight-and-level flight using out-the-window visual references
- 6.1.4.2 Adjust crab angle as necessary to maintain course
- 6.1.4.3 Turn onto upwind leg using a level, medium bank, gradually decreasing bank as turn progresses

Input Requirements:

- pitch, bank, and yaw attitude
- rate of change of pitch, bank, and yaw
- altitude
- heading
- airspeed
- power setting
- flaps setting
- relative position of nose of aircraft to horizon
- relative position of nose of aircraft to selected visual reference points
- position in relation to landmarks
- wind speed and direction

Output Requirements:

- rate of change of pitch, bank, and yaw
- engine power output
- flaps setting

Training Considerations

The user should be able to begin the task with the aircraft positioned in the air, at a point along any of the four legs, at an altitude comparable to the traffic pattern altitude, in straight-and-level flight, at a specified cruising speed. The task need not be performed in the order specified above, but transition from one leg to the next should be done in the manner specified above. The system should provide feedback regarding the maintenance of heading within 10°, airspeed within 10 kts, and altitude within 100 ft. Training must occur in both crosswind and no crosswind conditions and with various wind speeds. Both left and right patterns should be practiced.

Device Qualification Guidelines

Baseline qualification guidelines (see p. 5)

Displays:
The PCATD should have a 90° to the left, out-the-window display, representing at least a 45° horizontal field of view, and a 30° vertical field of view.
The PCATD should have a 90° to the right, out-the-window display, representing at least a 45 degree horizontal field of view, and a 30° vertical field of view.
Out-the-window view should be capable of showing sufficient terrain features and landmarks so that course control can be maintained at all times.

Flight Dynamics:
The presence and amount of wind are reflected in the handling and performance qualities of the simulated aircraft and are consistent with a single-engine, fixed gear, basic training aircraft with a fixed-pitch propeller.

Instructional Management:
Instructor can control the amount of wind encountered during the performance of the task both before the session begins and during the session.

Authorization: Private Pilot Certificate
Task Set: 6.0 Ground Reference Maneuvers
Task: 6.2 S-turns across a road

Learning Objectives

6.2.1 Fly downwind across road
- 6.2.1.1 Maintain straight-and-level flight using out-the-window visual references
- 6.2.1.2 Execute 180° turn immediately after crossing the road using a level, steep turn initially, decreasing bank angle and rate of turn as headwind component increases
- 6.2.1.3 Turn out on upwind leg precisely at completion of the turn

6.2.2 Fly upwind across road
- 6.2.2.1 Maintain straight-and-level flight using out-the-window visual references
- 6.2.2.2 Execute 180° turn immediately after crossing the road using a level, shallow turn initially, increasing bank angle and rate of turn as headwind component decreases
- 6.2.2.3 Turn out on downwind leg precisely at completion of the turn

Input Requirements:

- pitch, bank, and yaw attitude
- rate of change of pitch, bank, and yaw
- altitude
- heading
- airspeed
- power setting
- flaps setting
- relative position of nose of aircraft to horizon
- relative position of nose of aircraft to selected visual reference points
- position in relation to landmarks
- wind speed and direction

Output Requirements:

- rate of change of pitch, bank, and yaw
- engine power output
- flaps setting

Training Considerations

The user should be able to begin the task with the aircraft positioned in the air, at a point just prior to the road (or other comparable landmark such as a long straight fence, railroad tracks, etc.), at an altitude comparable to traffic pattern altitude, in straight-and-level flight, at a specified cruising speed. The system should provide feedback regarding the maintenance of heading within 10°, airspeed within 10 kts, and altitude within 100 ft. Training must occur in both crosswind and no crosswind conditions and with various wind speeds.

Device Qualification Guidelines

Baseline qualification guidelines (see p. 5)

Displays:

The PCATD should have a 90° to the left, out-the-window display, representing at least a 45° horizontal field of view, and a 30° vertical field of view.

The PCATD should have a 90° to the right, out-the-window display, representing at least a 45 degree horizontal field of view, and a 30° vertical field of view.

The out-the-window view should be capable of showing sufficient terrain features and landmarks so that course control can be maintained at all times.

Flight Dynamics:

The presence and amount of wind are reflected in the handling and performance qualities of the simulated aircraft and are consistent with a single-engine, fixed gear, basic training aircraft with a fixed-pitch propeller.

Instructional Management:

Instructor can control the amount of wind encountered during the performance of the task both before the session begins and during the session.

Authorization: Private Pilot Certificate
Task Set: 6.0 Ground Reference Maneuvers
Task: 6.3 Turns around a point

Learning Objectives

6.3.1 Fly downwind half of circle
- 6.3.1.1 Maintain altitude using out-the-window visual references
- 6.3.1.2 Execute 180° turn using a level, steep turn initially (bank not to exceed 45°), decreasing bank angle and rate of turn as headwind component increases

6.3.2 Fly upwind half of circle
- 6.3.2.1 Maintain altitude using out-the-window visual references
- 6.3.2.2 Execute 180° turn using a level, shallow turn initially, increasing bank angle and rate of turn as headwind component decreases

Input Requirements:

- pitch, bank, and yaw attitude
- rate of change of pitch, bank, and yaw
- altitude
- heading

- airspeed
- power setting
- flaps setting
- relative position of nose of aircraft to horizon
- relative position of nose of aircraft to selected visual reference points
- position in relation to landmarks
- wind speed and direction

Output Requirements:

- rate of change of pitch, bank, and yaw
- engine power output
- flaps setting

Training Considerations

The user should be able to begin the task with the aircraft positioned in the air, at a point just prior to beginning the turn, at an altitude comparable to traffic pattern altitude, in straight-and-level flight, at a specified cruising speed. The system should provide feedback regarding the maintenance of airspeed within 10 kts, and altitude within 100 ft. Training must occur in both crosswind and no crosswind conditions and with various wind speeds. Both left hand and right hand turns around a point should be practiced.

Device Qualification Guidelines

Baseline qualification guidelines (see p. 5)

Displays:
The PCATD should have a 90° to the left, out-the-window display, representing at least a 45° horizontal field of view, and a 30° vertical field of view.
PCATD should have a 90° to the right, out-the-window display, representing at least a 45 degree horizontal field of view, and a 30° vertical field of view.
Out-the-window view should be capable of showing sufficient terrain features and landmarks so that course control can be maintained at all times.

Flight Dynamics:
The presence and amount of wind are reflected in the handling and performance qualities of the simulated aircraft and are consistent with a single-engine, fixed gear, basic training aircraft with a fixed-pitch propeller.

Instructional Management:
The instructor can control the direction and amount of wind encountered during the performance of the task both before the session begins and during the session.

Table 8. Private Pilot Certificate Task Analysis: Navigation

Authorization: Private Pilot Certificate
Task Set: 7.0 Navigation
Task: 7.1 Pilotage and dead reckoning

Learning Objectives

7.1.1 Follow a preplanned course solely by reference to landmarks
- 7.1.1.1 Select two prominent landmarks along the desired course
- 7.1.1.2 Steer the airplane so that landmarks remain aligned over the nose
- 7.1.1.3 Select additional landmarks prior to reaching the closest landmark

7.1.2 Identify landmarks by relating surface features to chart symbols

7.1.3 Establish estimated time of arrival (ETA) for each checkpoint

7.1.4 Navigate by means of precomputed headings, groundspeeds, and elapsed time

7.1.5 Correct for and record the differences between preflight fuel, groundspeed, and heading calculations and those determined en route

7.1.6 Verify airplane position within 3 NM of the flight-planned route at all times

7.1.7 Arrive at en route checkpoints and destination within 5 min of ETA

7.1.8 Maintain appropriate altitude within 200 ft and established heading within 15°

Input Requirements:

- pitch, bank, and yaw attitude
- rate of change of pitch, bank, and yaw
- altitude
- heading
- airspeed
- power setting
- flaps setting
- relative position of nose of aircraft to horizon
- relative position of nose of aircraft to selected visual reference points
- position in relation to landmarks
- wind speed and direction
- fuel available
- time elapsed from a specified point

Output Requirements:

- rate of change of pitch, bank, and yaw
- engine power output
- flaps setting

Training Considerations

The user should be able to begin the task with the aircraft positioned in the air, at a point between two specified airports, at an altitude comparable to a normal cruising altitude, in straight-and-level flight, at a specified cruising speed. The system should provide feedback regarding the maintenance of airspeed within 10 kts, heading within 15°, and altitude within 200 ft. Training must occur in both crosswind and no crosswind conditions and with various wind speeds. Recognizable landmarks, local to the training facility, should be available in the navigational database. The simulation should be capable of supporting a cross-country flight of at least 100 nautical miles with landings at a minimum of three points, and one segment of the flight consisting of a straight-line distance of at least 50 nautical miles between the takeoff and landing locations (from FAR Part 141, appendix B, paragraph 5a1).

Device Qualification Guidelines

Baseline qualification guidelines (see p. 5)

Controls:
physical or virtual control for a clock or timer

Displays:
The PCATD should have a 90° to the left, out-the-window display, representing at least a 45° horizontal field of view, and a 30° vertical field of view.
The PCATD should have a 90° to the right, out-the-window display, representing at least a 45 degree horizontal field of view, and a 30° vertical field of view.
The out-the-window view should be capable of showing sufficient terrain features and landmarks so that aircraft control can be maintained at all times.
The PCATD should have a fuel gauge.

Flight Dynamics:
The presence and amount of wind are reflected in the handling and performance qualities of the simulated aircraft and are consistent with a single-engine, fixed gear, basic training aircraft with a fixed-pitch propeller.

Instructional Management:
Instructor can control the direction and amount of wind encountered during the performance of the task both before the session begins and during the session.
Navigational area database that is local to the training facility.

Authorization: Private Pilot Certificate
Task Set: 7.0 Navigation
Task: 7.2 Navigation systems and radar services

Learning Objectives

7.2.1 Select and identify appropriate navigation system/facility

7.2.2 Locate airplane position using radials, bearings, or coordinates, as appropriate

7.2.3 Intercept and track a given radial

7.2.4 Recognize indication of station passage

7.2.5 Recognize signal loss and take appropriate action

7.2.6 Use proper communication procedures when utilizing ATC radar services

7.2.7 Maintain appropriate altitude within 200 ft

Input Requirements:

- pitch, bank, and yaw attitude
- rate of change of pitch, bank, and yaw
- altitude
- heading
- airspeed
- power setting
- relative position of nose of aircraft to horizon
- relative position of nose of aircraft to selected visual reference points
- position in relation to landmarks
- wind speed and direction
- VOR station frequency and bearing
- Radio communications from ATC

Output Requirements:

- rate of change of pitch, bank, and yaw
- engine power output
- VOR station frequency
- Course deviation indicator setting
- Radio communications to ATC

Training Considerations

The user should be able to begin the task with the aircraft positioned in the air, at an altitude comparable to a normal cruising altitude, in straight-and-level flight, at a specified cruising speed. The system should provide feedback regarding the maintenance of airspeed within 10 kts, heading within 15°, and altitude within 200 ft. Training must occur in both crosswind and no crosswind conditions and with various wind speeds. The PCATD should have a local navigational database.

Device Qualification Guidelines

Baseline qualification guidelines (see p. 5)

Controls:
physical or virtual control for a communications radio, navigational radio and VOR
physical communications radio microphone or push-to-talk switch

Displays:
navigational radio and VOR with an aural, Morse code identification feature

Flight Dynamics:
The presence and amount of wind are reflected in the handling and performance qualities of the simulated aircraft and are consistent with a single-engine, fixed gear, basic training aircraft with a fixed-pitch propeller.

Instructional Management:
Instructor can control the direction and amount of wind encountered during the performance of the task both before the session begins and during the session.
Navigational area database that is local to the training facility

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Authorization: Private Pilot Certificate
Task Set: 7.0 Navigation
Task: 7.3 Diversion

Learning Objectives

7.3.1 Select an appropriate alternate airport and route

7.3.2 Divert promptly toward alternate airport

7.3.3 Estimate heading, groundspeed, arrival time, and fuel consumption to alternate airport

7.3.4 Maintain appropriate altitude within 200 ft and established heading within 15°

Input Requirements:

- pitch, bank, and yaw attitude
- rate of change of pitch, bank, and yaw
- altitude
- heading
- airspeed

- power setting
- relative position of nose of aircraft to horizon
- relative position of nose of aircraft to selected visual reference points
- position in relation to landmarks
- wind speed and direction
- VOR station frequency and bearing
- radio communications from ATC
- fuel available
- time elapsed from a specified point

Output Requirements:

- rate of change of pitch, bank, and yaw
- engine power output
- VOR station frequency
- course deviation indicator setting
- radio communications to ATC

Training Considerations

The user should be able to begin the task with the aircraft positioned in the air, at an altitude comparable to a normal cruising altitude, in straight-and-level flight, at a specified cruising speed. The system should provide feedback regarding the maintenance of airspeed within 10 kts, heading within 15°, and altitude within 200 ft. Training must occur in both crosswind and no crosswind conditions and with various wind speeds. The PCATD should have a local navigational database.

Device Qualification Guidelines

Baseline qualification guidelines (see p. 5)

Controls:
physical or virtual control for a communications radio, navigational radio and VOR
physical communications radio microphone or push-to-talk switch
physical or virtual control for a clock or timer

Displays:
The PCATD should have a 90° to the left, out-the-window display, representing at least a 45° horizontal field of view, and a 30° vertical field of view.
The PCATD should have a 90° to the right, out-the-window display, representing at least a 45 degree horizontal field of view, and a 30° vertical field of view.
A navigational radio and VOR with an aural, Morse code identification feature
fuel gauge are required.

Flight Dynamics:
The presence and amount of wind are reflected in the handling and performance qualities of the simulated aircraft and are consistent with a single-engine, fixed gear, basic training aircraft with a fixed-pitch propeller.

Instructional Management:
The instructor can control the direction and amount of wind encountered during the performance of the task both before the session begins and during the session.
Navigational area database that is local to the training facility is required.

Authorization: Private Pilot Certificate
Task Set: 7.0 Navigation
Task: 7.4 Lost procedures

Learning Objectives

7.4.1 Maintain original or appropriate heading and climb if necessary

7.4.2 Identify nearest concentration of prominent landmarks

7.4.3 Use navigation systems/facilities and/or contact an ATC facility for assistance

7.4.4 Plan precautionary landing if deteriorating weather and/or fuel exhaustion is imminent

Input Requirements:

- pitch, bank, and yaw attitude
- rate of change of pitch, bank, and yaw
- altitude
- heading
- airspeed
- power setting
- relative position of nose of aircraft to horizon
- relative position of nose of aircraft to selected visual reference points
- position in relation to landmarks
- wind speed and direction
- VOR station frequency and bearing
- radio communications from ATC
- fuel available
- time elapsed from a specified point

Output Requirements:

- rate of change of pitch, bank, and yaw
- engine power output
- VOR station frequency
- course deviation indicator setting
- radio communications to ATC

Training Considerations

The user should be able to begin the task with the aircraft positioned in the air, at an altitude comparable to a normal cruising altitude, in straight-and-level flight, at a specified cruising speed. The system should provide feedback regarding the maintenance of airspeed within 10 kts, heading within 15°, and altitude within 200 ft. Training must occur in both crosswind and no crosswind conditions and with various wind speeds. The PCATD should have a local navigational database. ATC communications can be provided by the instructor.

Device Qualification Guidelines

Baseline qualification guidelines (see p. 5)

Controls:
physical or virtual control for a communications radio, navigational radio and VOR
physical communications radio microphone or push-to-talk switch
physical or virtual control for a clock or timer

Displays:
The PCATD should have a 90° to the left, out-the-window display, representing at least a 45° horizontal field of view, and a 30° vertical field of view.
The PCATD should have a 90° to the right, out-the-window display, representing at least a 45 degree horizontal field of view, and a 30° vertical field of view.
A navigational radio and VOR with an aural, Morse code identification feature
fuel gauge are required.

Flight Dynamics:
The presence and amount of wind are reflected in the handling and performance qualities of the simulated aircraft and are consistent with a single-engine, fixed gear, basic training aircraft with a fixed-pitch propeller.

Instructional Management:
The instructor can control the direction and amount of wind encountered during the performance of the task both before the session begins and during the session.
A navigational area database that is local to the training facility is required.

Table 9. Private Pilot Certificate Task Analysis: Slow Flight and Stalls

Authorization: Private Pilot Certificate
Task Set: 8.0 Slow Flight and Stalls
Task: 8.1 Flight at slow airspeeds

Learning Objectives

8.1.1 Maintain straight-and-level flight

8.1.2 Transition to minimum controllable airspeed
- 8.1.2.1 Reduce throttle gradually from cruising position
- 8.1.2.2 Raise position of nose relative to horizon to maintain altitude within 100 ft
- 8.1.2.3 Lower full flaps as airspeed reaches maximum allowable speed for flap operation
- 8.1.2.4 Adjust pitch attitude to maintain altitude
- 8.1.2.5 Adjust power to maintain airspeed at $1.2V_{S1}$ +10/-5 kts
- 8.1.2.6 Maintain heading within 10°
- 8.1.2.7 Divide attention between instrument indications and outside visual references

8.1.3 Fly level turns at minimum controllable airspeed
- 8.1.3.1 Adjust pitch attitude and power to maintain airspeed and altitude
- 8.1.3.2 Maintain specified angle of bank, not to exceed 30° +0/-10°
- 8.1.3.3 Roll out on specified heading within 10°
- 8.1.3.4 Divide attention between instrument indications and outside visual references

8.1.4 Fly climbs and descents at minimum controllable airspeed
- 8.1.4.1 Adjust power to maintain airspeed
- 8.1.4.2 Adjust pitch attitude as necessary to establish desired rate of descent or climb
- 8.1.4.3 Level off from climb or descent within 100 ft
- 8.1.4.4 Divide attention between instrument indications and outside visual references

Input Requirements:

- pitch, bank, and yaw attitude
- rate of change of pitch, bank, and yaw
- altitude
- heading
- airspeed

- power setting
- relative position of nose of aircraft to horizon

Output Requirements:

- rate of change of pitch, bank, and yaw
- engine power output

Training Considerations

The user should be able to begin the task with the aircraft positioned in the air, at a reasonable altitude for maneuvering, in straight-and-level flight, at a specified cruising speed. The system should provide feedback regarding the maintenance of airspeed within +10/-5 kts, heading within 10°, bank within +0/-10°, and altitude within 100 ft. Both left- and right-hand level turns should be practiced, as well as climbing and descending turns.

Device Qualification Guidelines

Baseline qualification guidelines (see p. 5)

Displays:
The system should have a stall warning sound.

Authorization: Private Pilot Certificate
Task Set: 8.0 Slow Flight and Stalls
Task: 8.2 Power-off stalls

Learning Objectives

8.2.1 Maintain straight-and-level flight

8.2.2 Transition to normal approach configuration
- 8.2.2.1 Reduce throttle gradually to idle (or normal approach power) and apply carburetor heat if applicable
- 8.2.2.2 Maintain constant altitude (within 100 ft) until airspeed decelerates to that of normal approach airspeed
- 8.2.2.3 Adjust pitch attitude to normal approach attitude to maintain approach airspeed
- 8.2.2.4 Extend full flaps and adjust pitch attitude to maintain airspeed

8.2.3 Induce airplane stall
- 8.2.3.1 Apply back elevator pressure smoothly
- 8.2.3.2 Maintain heading within 10° using rudder (unless turning stall is being practiced)
- 8.2.3.3 Maintain wings level using aileron control
- 8.2.3.4 Maintain constant back elevator pressure until full stall occurs, evidenced by full-up eleveator, high sink rate, uncontrollable nose-down pitching, and possible buffeting

8.2.4 Recover from stall
- 8.2.4.1 Release back elevator pressure
- 8.2.4.2 Advance throttle smoothly to maximum allowable power (or not if recovery without adding power is being practiced)
- 8.2.4.3 Apply right rudder pressure to overcome engine torque effects as power is advanced and nose is lowered
- 8.2.4.4 Apply forward elevator pressure as necessary to regain airspeed
- 8.2.4.5 Adjust attitude as necessary to maintain straight-and-level flight

Input Requirements:

- pitch, bank, and yaw attitude
- rate of change of pitch, bank, and yaw

- altitude
- heading
- airspeed
- power setting
- relative position of nose of aircraft to horizon
- stall indications

Output Requirements:

- rate of change of pitch, bank, and yaw
- engine power output

Training Considerations

The user should be able to begin the task with the aircraft positioned in the air, at a reasonable altitude for maneuvering, in straight-and-level flight, at a specified cruising speed. The system should provide feedback regarding the maintenance of heading within 10°, the time required to recover from the stall, and the occurence of secondary stalls. Recovery from power-off stalls should be accomplished both with, and without, the addition of power.

Device Qualification Guidelines

Baseline qualification guidelines (see p. 5)

Displays:
The system should have a stall warning sound.

Authorization: Private Pilot Certificate
Task Set: 8.0 Slow Flight and Stalls
Task: 8.3 Power-on stalls

Learning Objectives

8.3.1 Maintain straight-and-level flight

8.3.2 Establish takeoff or departure configuration
- 8.3.2.1 Extend full flaps (depending on training objective)
- 8.3.2.2 Adjust pitch attitude to maintain altitude
- 8.3.2.3 Reduce power to allow airplane to slow to normal lift-off speed
- 8.3.2.4 Set power to normal take-off power
- 8.3.2.5 Establish normal climb attitude

8.3.3 Induce airplane stall
- 8.3.3.1 Apply back elevator pressure smoothly until unachievable climb attitude is established
- 8.3.3.2 Maintain heading within 10° using rudder (unless turning stall is being practiced)
- 8.3.3.3 Maintain wings level using aileron control
- 8.3.3.4 Maintain constant back elevator pressure until full stall occurs, evidenced by full-up eleveator, high sink rate, uncontrollable nose-down pitching, and possible buffeting

8.3.4 Recover from stall
- 8.3.4.1 Release back elevator pressure
- 8.3.4.2 Advance throttle smoothly to maximum allowable power
- 8.3.4.3 Apply forward elevator pressure as necessary to regain airspeed
- 8.3.4.4 Adjust attitude as necessary to maintain straight-and-level flight
- 8.3.4.5 Adjust throttle to cruise power setting

Input Requirements:

- pitch, bank, and yaw attitude
- rate of change of pitch, bank, and yaw
- altitude
- heading
- airspeed
- power setting
- relative position of nose of aircraft to horizon
- stall indications

Output Requirements:

- rate of change of pitch, bank, and yaw
- engine power output

Training Considerations

The user should be able to begin the task with the aircraft positioned in the air, at a reasonable altitude for maneuvering, in straight-and-level flight, at a specified cruising speed. The system should provide feedback regarding the maintenance of heading within 10°, the time required to recover from a stall, and the occurence of secondary stalls.

Device Qualification Guidelines

Baseline qualification guidelines (see p. 5)

Displays:
The system should have a stall warning sound.

Authorization: Private Pilot Certificate
Task Set: 8.0 Slow Flight and Stalls
Task: 8.4 Spin recovery

Learning Objectives

8.4.1 Recognize entry into a spin

8.4.2 Recover from a spin
- 8.4.2.1 Move throttle to idle position
- 8.4.2.2 Apply full opposite rudder
- 8.4.2.3 Apply quick, positive, straight-forward movement of elevator control after rotation slows
- 8.4.2.4 Maintain elevator control in position
- 8.4.2.5 Neutralize rudder position after spin rotation stops
- 8.4.2.6 Apply back elevator pressure to raise nose to level flight

Input Requirements:

- pitch, bank, and yaw attitude
- rate of change of pitch, bank, and yaw
- altitude
- heading
- airspeed
- power setting
- relative position of nose of aircraft to horizon
- relative position of nose of aircraft to outside visual references
- stall indications

Output Requirements:

- rate of change of pitch, bank, and yaw
- engine power output

Training Considerations

The user should be able to begin the task with the aircraft positioned in the air, at a reasonable altitude for maneuvering, in straight-and-level flight, at a specified cruising speed. The system should provide feedback regarding the time required to recover from spin, the occurence of secondary spins, and the amount of altitude lost during spin recovery. The user should be able to produce a spin situation at a time indicated by the instructor. Both left- and right-hand spins should be practiced.

Device Qualification Guidelines

Baseline qualification guidelines (see p. 5)

Displays:
The system should have a stall warning sound.
The out-the-window view should be capable of showing sufficient terrain features and landmarks so that aircraft control can be maintained at all times

Flight Dynamics:
Flight dynamics should allow the pilot to produce a spin and recover from a spin.

Table 10. Private Pilot Certificate Task Analysis: Basic Instrument Maneuvers

Authorization: Private Pilot Certificate
Task Set: 9.0 Basic Instrument Maneuvers
Task: 9.1 Straight-and-level flight

Learning Objectives

9.1.1 Scan each primary flight instrument in the order and at a sampling rate determined by the mission segment

9.1.2 Maintain altitude within 100 ft
- 9.1.2.1 Monitor attitude indicator, altimeter, vertical speed indicator, and airspeed indicator
- 9.1.2.2 Use half-bar-width correction in attitude indicator for altitude errors of less than 100 ft
- 9.1.2.3 Use full-bar-width correction in attitude indicator for altitude errors of 100 ft or more
- 9.1.2.4 Make an attitude change to correct altitude errors that will result in a vertical speed approximately double the error in altitude but never exceeding the optimum rate of climb or descent for a given airspeed and configuration
- 9.1.2.5 Recall lag characteristics of vertical speed indicator when monitoring instrument

9.1.3 Maintain heading within 10°
- 9.1.3.1 Monitor attitude indicator, heading indicator, and turn coordinator
- 9.1.3.2 Make correction for heading errors by using an angle of bank no greater than number of degrees to be turned and never greater than that required for a standard-rate turn

9.1.4 Maintain airspeed within 10 kts
- 9.1.4.1 Monitor airspeed indicator, attitude indicator, altimeter, and engine power output indicator
- 9.1.4.2 Determine need for a change in pitch and/or power based on relationship between altitude and airspeed
- 9.1.4.3 Make initial power changes greater than desired setting to accelerate rate of airspeed change except for small speed changes
- 9.1.4.4 Apply aileron and rudder pressures when increasing power to counteract left yaw and roll tendencies

9.1.5 Make small adjustments in controls with light control pressures to correct for deviations in attitude
- 9.1.5.1 Make adjustments in controls to stop movement of instrument indications
- 9.1.5.2 Make adjustments in controls to return to desired altitude, heading or airspeed

Input Requirements:

- pitch, bank, and yaw attitude
- rate of change of pitch, bank, and yaw
- altitude, heading, and airspeed
- power setting

Output Requirements:

- rate of change of pitch, bank, and yaw
- engine power output

Training Considerations

The user should be able to configure the system such that training on the task can begin with the aircraft positioned in the air, at a reasonable altitude for maneuvering, in straight-and-level flight, at a specified cruising speed. The system should provide feedback regarding the maintenance of heading within 20°, airspeed within 10 kts, and altitude within 200 ft.

Device Qualification Guidelines

Baseline qualification guidelines (see p. 5)

Instructional Management:
The out-the-window view should be blanked out or covered up.

Authorization: Private Pilot Certificate
Task Set: 9.0 Basic Instrument Maneuvers
Task: 9.2 Constant airspeed climb to altitude

Learning Objectives

9.2.1 Maintain straight-and-level flight

9.2.2 Transition from staight-and-level flight to a constant airspeed climb configuration
- 9.2.2.1 Set full power and approximate pitch for required climb speed in a smooth and timely manner
- 9.2.2.2 Make proper use of trim control
- 9.2.2.3 Scan continuously without excessive fixation or omission
- 9.2.2.4 Make small adjustments in controls to correct for deviations in climb speed and heading

9.2.3 Transition from a constant airspeed climb to straight-and-level flight at desired altitude
- 9.2.3.1 Begin level off at appropriate point prior to reaching desired altitude (10% rule)
- 9.2.3.2 Set approximate pitch and power for straight-and-level flight
- 9.2.3.3 Make proper use of trim control
- 9.2.3.4 Scan continuously without excessive fixation or omission
- 9.2.3.5 Make small adjustments in controls to correct for deviations in attitude

Input Requirements:

- pitch, bank, and yaw attitude
- rate of change of pitch, bank, and yaw
- altitude, heading, and airspeed
- power setting
- pitch trim setting

Output Requirements:

- rate of change of pitch, bank, and yaw
- engine power output
- pitch trim

Training Considerations

The user should be able to configure the system such that training on the task can begin with the aircraft positioned in the air, at a reasonable altitude for maneuvering, in straight-and-level flight, at a specified cruising speed. The system should provide feedback regarding the maintenance of heading within 20°, airspeed within 10 kts, and altitude within 200 ft. In addition, since the trainee is transitioning from one altitude to another, feedback should be provided both in maintaining the initial altitude, and in achieving and maintaining the second altitude.

Device Qualification Guidelines

Baseline qualification guidelines (see p. 5)

Instructional Management:
The out-the-window view should be blanked out or covered up.

Authorization: Private Pilot Certificate
Task Set: 9.0 Basic Instrument Maneuvers
Task: 9.3 Constant airspeed descent to altitude

Learning Objectives

9.3.1 Maintain straight-and-level flight

9.3.2 Transition from staight-and-level flight to a constant airspeed descent configuration
- 9.3.2.1 Set approximate pitch and power for required descent speed in a smooth and timely manner
- 9.3.2.2 Set flaps to stage 1 (depending on training goal)
- 9.3.2.3 Make proper use of trim control
- 9.3.2.4 Scan continuously without excessive fixation or omission
- 9.3.2.5 Make small adjustments in controls to correct for deviations in descent speed and heading

9.3.3 Transition from a constant airspeed descent to straight-and-level flight at desired altitude
- 9.3.3.1 Begin level off at appropriate point prior to reaching desired altitude (10% rule)
- 9.3.3.2 Set flaps to full up.
- 9.3.3.3 Set approximate pitch and power for straight-and-level flight
- 9.3.3.4 Make proper use of trim control
- 9.3.3.5 Scan continuously without excessive fixation or omission
- 9.3.3.6 Make small adjustments in controls to correct for deviations in attitude

Input Requirements:

- pitch, bank, and yaw attitude
- rate of change of pitch, bank, and yaw
- altitude, heading, and airspeed
- power setting
- pitch trim setting
- flaps setting

Output Requirements:

- rate of change of pitch, bank, and yaw
- engine power output
- pitch trim
- flaps setting

Training Considerations

The user should be able to configure the system such that training on the task can begin with the aircraft positioned in the air, at a reasonable altitude for maneuvering, in straight-and-level flight, at a specified cruising speed. The system should provide feedback regarding the maintenance of heading within 20°, airspeed within 10 kts, and altitude within 200 ft. In addition, since the trainee is transitioning from one altitude to another, feedback should be provided both in maintaining the initial altitude, and in achieving and maintaining the second altitude.

Device Qualification Guidelines

Baseline qualification guidelines (see p. 5)

Instructional Management:
The out-the-window view should be blanked out or covered up.

Authorization: Private Pilot Certificate
Task Set: 9.0 Basic Instrument Maneuvers
Task: 9.4 Turns to headings

Learning Objectives

9.4.1 Maintain straight-and-level flight

9.4.2 Transition from straight-and-level flight to level standard rate turn
- 9.4.2.1 Apply coordinated aileron and rudder pressures in desired direction of turn
- 9.4.2.2 Roll into turn at a rate based on rate of instrument cross-check and interpretation
- 9.4.2.3 Establish the approximate angle of bank needed for a standard rate turn (dependent on airspeed, use TAS/10 + 5 for approximate angle of bank) using attitude indicator, then check miniature aircraft of turn coordinator for a standard rate turn indication
- 9.4.2.4 Make pitch adjustments necessary as vertical lift component decreases with increase in bank using altimeter, vertical speed indicator, and attitude indicator
- 9.4.2.5 Maintain constant airspeed using airspeed indicator
- 9.4.2.6 Scan continuously without excessive fixation or omission

9.4.3 Maintain turn
- 9.4.3.1 Use turn coordinator as primary bank instrument and attitude indicator as supporting bank instrument
- 9.4.3.2 Control yaw using ball of turn coordinator
- 9.4.3.3 Make proper use of trim control
- 9.4.3.4 Scan continuously without excessive fixation or omission
- 9.4.3.5 Make small adjustments in controls to correct for deviations in altitude, bank angle, yaw (yoke and rudder pedals) and airspeed (throttle)

9.4.4 Transition from turning to straight-and-level flight at desired heading
- 9.4.4.1 Begin rolling out of turn at a point before reaching desired heading approximately equal to half your angle of bank
- 9.4.4.2 Apply coordinated aileron and rudder pressures opposite direction of turn
- 9.4.4.3 Roll out of turn at same rate as was used to roll in to turn
- 9.4.4.4 Initiate turn recovery using attitude indicator as primary bank instrument
- 9.4.4.5 Use heading indicator as primary bank instrument when airplane is approximately level, as in straight-and-level flight

9.4.4.6 Scan continuously without excessive fixation or omission
9.4.4.7 Make pitch, power and trim adjustments as changes in vertical lift component and airspeed occur

9.4.5 Maintain straight-and-level flight

Input Requirements:
- pitch, bank, and yaw attitude
- rate of change of pitch, bank, and yaw
- altitude, heading, and airspeed
- power setting
- pitch trim setting

Output Requirements:
- rate of change of pitch, bank, and yaw
- engine power output
- pitch trim

Training Considerations

The user should be able to configure the system such that training on the task can begin with the aircraft positioned in the air, at a reasonable altitude for maneuvering, in straight-and-level flight, at a specified cruising speed. The system should provide feedback regarding the maintenance of heading within 20°, airspeed within 10 kts, bank within 10° and altitude within 200 ft. In addition, since the trainee is transitioning from one heading to another, feedback should be provided both in maintaining the initial heading, and in achieving and maintaining the second heading. The trainee should receive practice at turning both left and right through various degrees of heading changes.

Device Qualification Guidelines

Baseline qualification guidelines (see p. 5)

Instructional Management:
The out-the-window view should be blanked out or covered up.

Authorization: Private Pilot Certificate
Task Set: 9.0 Basic Instrument Maneuvers
Task: 9.5 Recovery from unusual attitudes

Learning Objectives

9.5.1 Recognize unusual attitude
9.5.1.1 Note an instrument rate of movement or indication other than those associated with basic instrument flight maneuvers
9.5.1.2 Increase speed of scan
9.5.1.3 Distinguish between unusual attitude, instrument error, or instrument malfunction

9.5.2 Initiate recovery by reference to airspeed indicator, altimeter, VSI, and turn coordinator (not attitude indicator)

9.5.3 Recover from a nose-high attitude
9.5.3.1 Increase power as necessary in proportion to observed deceleration
9.5.3.2 Apply forward elevator pressure to lower nose and prevent a stall
9.5.3.3 Correct bank by applying coordinated aileron and rudder pressure to level miniature aircraft and center ball of turn coordinator
9.5.3.4 Apply corrective control applications almost simultaneously but in sequence given above

9.5.4 Recover from a nose-low attitude

9.5.4.1 Reduce power to prevent excessive airspeed and loss of altitude if airspeed is increasing or is above desired airspeed

9.5.4.2 Correct bank attitude with coordinated aileron and rudder pressure to straight flight by referring to turn coordinator

9.5.4.3 Raise nose to level flight attitude by smooth back elevator pressure

9.5.4.4 Apply corrective control applications almost simultaneously but in sequence given above

9.5.5 Confirm recovery by reference to level miniature aircraft and centered ball of turn coordinator

Input Requirements:

- pitch, bank, and yaw attitude
- rate of change of pitch, bank, and yaw
- altitude, heading, and airspeed
- power setting

Output Requirements:

- rate of change of pitch, bank, and yaw
- engine power output

Training Considerations

The user should be able to begin the task with the aircraft positioned in the air, at a reasonable altitude for maneuvering, at a pitch angle greater than ±25°, and a bank angle greater than ±40°, with an airspeed dependent on attitude but greater than stall and less than V_A. The system should provide feedback regarding following the appropriate sequence of actions required to return to straight-and-level flight. Recovery from unusual attitudes should be practiced from both nose high and nose low positions and banked both left and right.

Device Qualification Guidelines

Baseline qualification guidelines (see p. 5)

Instructional Management:

Independent of the simulation, the user is able to manipulate aircraft attitude.

User receives feedback regarding whether pitch, bank, and power corrections are made in an appropriate sequence to return aircraft to straight-and-level flight.

The out-the-window view should be blanked out or covered up.

Authorization: Private Pilot Certificate

Task Set: 9.0 Basic Instrument Maneuvers

Task: 9.6 Radio communications/radar services

Learning Objectives

9.6.1 Select proper frequency on navigation radio and ident

9.6.2 Follow verbal instructions and/or navigation systems/facilities for guidance

9.6.3 Determine minimum safe altitude

9.6.4 Maintain altitude within 200 ft, heading within 20°, and airspeed within 10 kts

Input Requirements:

- pitch, bank, and yaw attitude
- rate of change of pitch, bank, and yaw
- altitude, heading, and airspeed

- power setting
- navigational and communications radio settings
- aural Morse code identification feature
- VOR course direction indication
- ATC navigation instructions

Output Requirements:

- rate of change of pitch, bank, and yaw
- engine power output
- navigational and communications radio settings
- identification button for navigation radio
- VOR setting
- radio microphone

Training Considerations

The user should be able to begin the task with the aircraft positioned in the air, at a reasonable altitude for maneuvering. The system should provide feedback regarding the maintenance of altitude within 200 ft, heading within 20°, and airspeed within 10 kts. ATC communications can be provided by the instructor.

Device Qualification Guidelines

Baseline qualification guidelines (see p. 5)

Controls:
The PCATD contains a physical or virtual control for a communications radio, navigational radio and VOR.
A physical communications radio microphone or push-to-talk switch is available.

Displays:
A navigational radio and VOR with an aural, Morse code identification feature is available.

Instructional Management:
The out-the-window view should be blanked out or covered up.
A navigational area database that is local to the training facility is available.

Table 11. Private Pilot Certificate Task Analysis: Emergency Operations

Authorization: Private Pilot Certificate
Task Set: 10.0 Emergency Operations
Task: 10.1 Emergency descents

Learning Objectives

10.1.1 Recognize need for emergency descent

10.1.2 Establish recommended emergency descent configuration and airspeed, and maintain airspeed within 5 kts

10.1.3 Follow appropriate emergency checklist

Input Requirements:

- pitch, bank, and yaw attitude
- rate of change of pitch, bank, and yaw
- altitude, heading, and airspeed
- power setting
- flaps setting

Output Requirements:

- rate of change of pitch, bank, and yaw
- engine power output
- flaps switch

Training Considerations

The user should be able to begin the task with the aircraft positioned in the air, at a reasonable altitude for maneuvering. The system should provide feedback regarding the change of altitude during the descent.

Device Qualification Guidelines

Baseline qualification guidelines (see p. 5)

Authorization: Private Pilot Certificate
Task Set: 10.0 Emergency Operations
Task: 10.2 Emergency approach and landing

Learning Objectives

10.2.1 Recognize engine failure

10.2.2 Configure aircraft for maximum glide
- 10.2.2.1 Set flaps up
- 10.2.2.2 Place wings level
- 10.2.2.3 Place nose down to appropriate attitude

10.2.3 Perform engine failure checklist
- 10.2.3.1 Set mixture rich
- 10.2.3.2 Turn on carburetor heat
- 10.2.3.3 Check magneto switch set on "BOTH"
- 10.2.3.4 Check fuel quantity

10.2.4 Select a suitable emergency landing area within gliding distance

10.2.5 Plan and follow a pattern to landing area considering altitude, wind, terrain, and obstructions

Input Requirements:

- pitch, bank, and yaw attitude
- rate of change of pitch, bank, and yaw
- altitude, heading, and airspeed
- power setting
- flaps setting
- engine status (working/not working)
- carburetor heat setting
- magneto switch setting
- fuel quantity
- fuel mixture setting
- relationship of aircraft to potential landing areas

Output Requirements:

- rate of change of pitch, bank, and yaw
- engine power output
- flaps switch

- carburetor heat setting
- magneto switch setting
- fuel mixture setting

Training Considerations

The user should be able to begin the task with the aircraft positioned in the air, at a reasonable altitude for maneuvering, in straight-and-level flight, at a specified cruising speed. The system should provide feedback regarding the maintenance of heading within 10°, airspeed within 10 kts, bank within 5° and altitude within 100 ft. The instructor should have the ability to cause a simulated engine failure during the course of a task.

Device Qualification Guidelines

Baseline qualification guidelines (see p. 5)

Controls:
Physical or virtual controls for carburetor heat, magneto switch, and fuel mixture are available.

Displays:
The PCATD includes a 90° to the left, out-the-window display, representing at least a 45° horizontal field of view, and a 30° vertical field of view.
The PCATD includes a 90° to the right, out-the-window display, representing at least a 45 degree horizontal field of view, and a 30° vertical field of view.
The PCATD includes a display showing status of carburetor heat, magneto switch, fuel mixture, and fuel quantity.

Flight Dynamics:
The handling and performance qualities of the simulated aircraft during simulated engine failure are consistent with a single-engine, fixed gear, basic training aircraft with a fixed-pitch propeller.

Instructional Management:
Instructor can control the presence of an engine failure during a training session.

Table 12. Private Pilot Certificate Task Analysis: Night Operations

Authorization: Private Pilot Certificate
Task Set: 11.0 Night Operations
Task: 11.1 Night preparation

Learning Objectives

The learning objective of this task is to acquire the ability to perform the following: 1) explain the physiological aspects of night flying, including the effects of changing light conditions, coping with illusions, and how the pilot's physical condition affects visual acuity; 2) identify airports, runways, taxiways, obstructions, and pilot controlled lighting; 3) explain airplane lighting systems; 4) identify personal equipment essential for night flight; and 5) explain night orientation, navigation, and chart reading techniques.

Input Requirements:

- night flying information as listed above

Output Requirements:

- demonstration of understanding of night flying information as listed above

Training Considerations

The demonstration of an understanding of night flying information can be accomplished using the PCATD by having the system elicit information from the trainee through multiple choice questions, filling in blanks, etc. At a minimum, the system should provide feedback to the student regarding areas in need of review.

Device Qualification Guidelines

Displays:
The PCATD can display all of the various forms of night flying information.

Instructional Management:
The PCATD can test knowledge of night flying through multiple choice questions, fill-in-the blanks, etc. and provide feedback on areas of knowledge that are lacking.

Authorization: Private Pilot Certificate
Task Set: 11.0 Night Operations
Task: 11.2 Night flight

Learning Objectives

The learning objectives of this task are similar to the equivalent daylight activities of the following tasks: 1) taxiing (task 2.4); 2) pilotage and dead reckoning (task 7.1); 3) takeoff and climb (task 5.1); and 4) approach and landing (task 5.2). The difference in system requirements is that imposed on out-the-window views.

Input Requirements:

- flight control position
- power setting
- aircraft position at airport
- brake status
- pitch, bank, and yaw attitude
- rate of change of pitch, bank, and yaw
- altitude
- heading
- airspeed
- flaps setting
- relative position of nose of aircraft to horizon
- relative position of nose of aircraft to selected visual reference points
- position in relation to landmarks
- wind speed and direction
- fuel available
- time elapsed from a specified point

Output Requirements:

- flight control position
- power setting
- rudder position
- brake setting
- rate of change of pitch, bank, and yaw
- engine power output
- flaps setting

Training Considerations

The training considerations of this task are similar to the equivalent daylight activities of the following tasks: 1) taxiing (task 2.4); 2) pilotage and dead reckoning (task 7.1); 3) takeoff and climb (task 5.1); and 4) approach and landing (task 5.2). The difference in system requirements is that imposed on out-the-window views.

Device Qualification Guidelines

Baseline qualification guidelines (see p. 5)

Controls:
The PCATD includes a physical or virtual control for a clock or timer.

Displays:
The out-the-window display should show a nighttime scene.
The out-the-window display should include airport runway and taxiways.
The PCATD should have a 90° to the left, out-the-window display, representing at least a 45° horizontal field of view, and a 30° vertical field of view.
The PCATD should have a 90° to the right, out-the-window display, representing at least a 45 degree horizontal field of view, and a 30° vertical field of view.

Flight Dynamics:
The presence and amount of wind are reflected in the handling and performance qualities of the simulated aircraft and are consistent with a single-engine, fixed gear, basic training aircraft with a fixed-pitch propeller.

Instructional Management:
The instructor can control the direction and amount of wind encountered during the performance of the task both before the session begins and during the session.
A navigational area database that is local to the training facility is available.

Additional Qualification Guidelines
In addition to the baseline qualification guidelines listed at the front of this document (guidelines 1-19, pp. 7-9), the following guidelines were added.

Controls:
20. The PCATD should have physical controls for the following:
    carburetor heat
    mixture control
    master switch
    brake
    ignition switch.
21. The PCATD should have physical controls for the following:
    altitude setting adjustment
    heading indicator adjustment.
22. The PCATD should have a physical communications radio microphone or a push-to-talk switch.
23. The PCATD should have a physical control for a clock or timer.
24. The PCATD should have physical controls for a communications radio, navigational radio and VOR.

Displays:
25. The PCATD should have a clock or timer display.
26. The PCATD should have an oil pressure guage.
27. The PCATD should have a visual or aural indication that the engine is running.
28. The altitude indicator should have a barometric pressure indicator.
29. The out-the-window view should be capable of showing runway features and markings.
30. The PCATD should provide auditory signal to indicate contact between wheels and runway surface.
31. The PCATD should have a 90° to the left, out-the-window display, representing at least a 45° horizontal field of view, and a 30° vertical field of view.
32. The PCATD should have a 90° to the right, out-the-window display, representing at least a 45 degree horizontal field of view, and a 30° vertical field of view.
33. The out-the-window view should be capable of showing sufficient terrain features and landmarks so that course control can be maintained at all times.

34. The PCATD should have a fuel gauge.
35. The PCATD should have a navigational radio and VOR with an aural, Morse code identification feature.
36. The PCATD should have a stall warning sound.
37. The out-the-window display should be capable of showing a nighttime scene.

Flight Dynamics:

38. The presence and amount of wind are reflected in the handling and performance qualities of the simulated aircraft and are consistent with a single-engine, fixed gear, basic training aircraft with a fixed-pitch propeller.
39. Flight dynamics should allow a pilot to produce a spin and recover from a spin.
40. The handling and performance qualities of the simulated aircraft during simulated engine failure are consistent with a single-engine, fixed gear, basic training aircraft with a fixed-pitch propeller.

Instructional Management:

41. The PCATD tests knowledge of certificates and documents through multiple choice questions, fill-in-the blanks, etc. and provides feedback on areas of knowledge that are lacking.
42. The PCATD tests knowledge of weather through multiple choice questions, fill-in-the blanks, etc. and provides feedback on areas of weather-related knowledge that are lacking.
43. The PCATD provides feedback regarding the selection of route segments and checkpoints, the computation of headings, distances, airspeed, wind data, groundspeed, time enroute, estimated time between check points, fuel required, weight and balance, and the correct procedures for completing and filing a flight plan.
44. The PCATD tests knowledge of the national airspace system through multiple choice questions, fill-in-the blanks, etc. and provides feedback on areas of knowledge that are lacking.
45. The PCATD tests knowledge of aircraft peformance and limitations through multiple choice questions, fill-in-the blanks, etc. and provides feedback on areas of knowledge that are lacking.
46. The PCATD tests knowledge of aircraft systems and their operating characteristics through multiple choice questions, fill-in-the blanks, etc. and provides feedback on areas of knowledge that are lacking.
47. The PCATD tests knowledge of the content and use of minimum equipment lists through multiple choice questions, fill-in-the blanks, etc. and provides feedback on areas of knowledge that are lacking.
48. The PCATD tests knowledge of aeromedical factors through multiple choice questions, fill-in-the blanks, etc. and provides feedback on areas of knowledge that are lacking.
49. The PCATD tests knowledge of preflight inspection through multiple choice questions, fill-in-the blanks, etc. and provides feedback on areas of knowledge that are lacking.
50. The PCATD tests knowledge of cockpit management procedures through multiple choice questions, fill-in-the blanks, etc. and provides feedback on areas of knowledge that are lacking.
51. The PCATD tests knowledge of ATC light signals through multiple choice questions, fill-in-the blanks, etc. and provides feedback on areas of knowledge that are lacking.
52. The instructor can control the amount of wind encountered during the performance of the task both before the session begins and during the session.
53. The PCATD tests knowledge of airport and runway marking and lighting through multiple choice questions, fill-in-the blanks, etc. and provide feedback on areas of knowledge that are lacking.
54. A navigational area database that is local to the training facility is available.
55. The PCATD out-the-window view can be blanked out or covered up.
56. Prior to beginning a simulation, the user is able to establish the aircraft's attitude, including both bank and pitch angle.
57. The instructor can control the presence of an engine failure during a training session.
58. The PCATD tests knowledge of night flying through multiple choice questions, fill-in-the blanks, etc. and provides feedback on areas of knowledge that are lacking.

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Appendix A

PCATD APPROVAL TEST GUIDE: PRIVATE PILOT TRAINING

Prototype Version - For Research Purposes Only

For Use in Review and Approval of Part 141 Integrated Ground and Flight Training Curricula Including a Personal Computer-Based Aviation Training Device (PCATD)

Developed By:

Human Factors Research Laboratory
Civil Aeromedical Institute (CAMI)
Oklahoma City, Oklahoma

November, 1994

PCATD APPROVAL TEST GUIDE - DATA SHEET

Petitioner: _____ Date: _____

Flight Standards District Office: _____

Inspector: _____

Description of Candidate PCATD:

_____

_____

_____

_____

_____

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Evaluation Results

Curriculum Approved? ____Yes ____No

Baseline Guidelines Failed (List Numbers): _____

Failed Tasks (List Numbers): _____

_____

Comments: _____

_____

_____

_____

_____

_____

_____

PCATD APPROVAL TEST GUIDE - INSTRUCTIONS FOR USE

Purpose

This guide describes the use of the PCATD Approval Test Guide (ATG) to review a proposed Part 141 flight school curriculum that includes the use of a personal computer-based aviation training device (PCATD) as part of an integrated ground and flight training curriculum. The ATG is intended for use initially by Flight Standards District Office (FSDO) safety inspectors.

Procedure

The ATG is composed of two sets of guidelines: (1) baseline qualification guidelines that must be met by the candidate PCATD to fulfill minimum standards for acceptance; and 2) extended qualification guidelines that must be met for use of the candidate PCATD for specific training tasks. Table 1 lists the baseline qualification guidelines. Table 2 lists the extended qualification guidelines. Table 3 is a training task checklist for determining which of the extended guidelines are required for the PCATD to meet the intended training goals of the Part 141 flight school. Application of the ATG involves 5 sequential steps:

Step 1: Obtain PCATD Descriptive Information

Descriptive information should be obtained from the Part 141 petitioner on the candidate PCATD. This information must be sufficiently detailed to support application of the ATG.

Step 2: Compare Baseline Guidelines with PCATD Specification

Using the Baseline Qualification Guidelines Checklist (Table 1), compare each requirement against the PCATD specification. Indicate compliance in the spaces provided in the checklist. It may be helpful to conduct a test flight of the system. Determination of system transport delay and screen update rate (guidelines 5 and 9) can be made subjectively if insufficient information is provided by the PCATD developer. Treat each of the baseline qualification guidelines as Pass/Fail. All conditions of a given guideline must be met for a candidate PCATD to be passed on that guideline (see guidelines 6 and 10). Note any failed baseline guidelines in the space provided on the summary page of this guide.

Step 3: Identify Flight Tasks to be Trained Using the PCATD

Using the training task checklist provided in Table 3, and a copy of the prospective Part 141 training curriculum, identify those tasks that are proposed to be trained using the candidate PCATD. Place a check mark to the left of each flight task to be trained using the PCATD. If necessary, hold interviews with flight school instructors to amplify curriculum information.

Step 4: Assess Candidate PCATD on Individual Flight Tasks

To the right of each task in the Training Task Checklist is a row of zero or more numbers. These numbers identify additional qualification guidelines that must be met for a PCATD to be used to train that task. These guidelines are an extension to the baseline qualification guidelines. If no numbers are listed beside the task it indicates that no additional giudelines beyond those in the basline set are required. The numbers in the checklist correspond to the list of extended guidelines presented in Table 2. For each task checked, determine if the PCATD meets all of the extended guidelines listed for that task. Mark off each guideline as it is passed by making an "X" on the guideline number. If a PCATD fails to meet all of the guidelines for a particular task, list the task number in the appropriate space provided on the summary page of this guide.

Step 5: Approve or Disapprove the Curriculum

If the PCATD meets all of the baseline qualification guidelines, and is qualified to train all of the indicated tasks, then the curriculum shall be approved. Indicate approval or disapproval of the curriculum in the appropriate space on the summary page of this guide. If the curriculum is disapproved, use the Comments portion of the summary page to indicate the reasons for the disapproval.

Table 1: Baseline Qualification Guidelines Checklist

Controls.

Controls used in the PC-based simulation device can be of two types, both physical and virtual. Both types of controls should be recognizable as to their function and how they can be manipulated solely from their appearance. This requirement eliminates the use of a keyboard to control the simulated aircraft (although a keyboard may still be used in controlling aspects of the simulation such as setting initial aircraft state, location, wind, etc.). A physical control is an actual physical object that, when manipulated, provides input to the flight simulation. A virtual control is defined here as a realistic graphical representation of a physical control, displayed on the computer screen, that can be unambiguously manipulated through the use of a computer input device. An example of a virtual control is a realistic-looking flaps switch that is displayed on the computer screen and manipulated through any computer cursor-control device, such as a mouse, or more directly with touch-screen technology. The cursor is positioned on the flaps switch and "pressed" by an appropriate action with the input device. A virtual control provides a sense of direct manipulation of a control without requiring the presence of external hardware. The baseline qualification guidelines for controls are as follows:

___1. A physical, self-centering, displacement yoke or control stick that allows continuous adjustment to rate of change of pitch and bank.
___2. Physical, self-centering rudder pedals that allow continuous adjustment to rate of change of yaw.
___3. A physical throttle control that allows continuous movement from idle to full power settings.
___4. Physical or virtual controls for the following items:
    flaps
    pitch trim
    It is not necessary that the pitch trim control relieve control pressure as it does in an actual aircraft. However, the pitch trim control might allow the simulated aircraft to be stabilized at any particular pitch attitude with the yoke or control stick in the neutral position.
___5. Time from control input to recognizable system response (transport delay) should be 300 milliseconds or less.

Displays.

___6. Displays represented should include:
    altimeter
    heading indicator
    airspeed indicator
    vertical speed indicator
    turn and bank coordinator
    attitude indicator
    tachometer
    flaps setting
    pitch trim indication
    magnetic compass.
___7. Relative layout of the primary displays must correspond to the standard "T" configuration with (a) airspeed, (b) attitude and (c) altimeter forming the "cap" with (d) the heading indicator, located in the "stem" below the attitude indicator.

___8. Size, shape, and information content of displays should resemble those found commonly in a single-engine, fixed-pitch propeller, basic training aircraft with a fixed gear.

___9. Display update should be 10Hz or faster and be free of distracting rastering, stepping, aliasing, or quantization.

___10. The smallest display changes should be discriminable from pilot's normal operating position and correspond to the following information:

Airspeed indicator	Change of 5mph or less in airspeed
Attitude indicator	Change of 2° or less pitch or bank
Altimeter	Change of 10ft. or less in altitude
Turn and bank	Change of 1/4 standard rate turn or less
Heading indicator	Change of 2° or less in heading
VSI	Change of 100 ft. per min. or less in vertical speed
Tachometer	Change of 25 RPM or less in engine RPM

___11. Displays should reflect dynamic behavior of an actual aircraft display (e.g., VSI reading of -500fpm is reflected by a corresponding movement in altimeter, an increase in throttle is reflected by an immediate increase in RPM indicator, etc.).

___12. Device should have a forward, out-the-window display, representing at least a 45° horizontal field of view, and a 30° vertical field of view. The out-the-window display should include a horizon, useful visual references for monitoring path of aircraft, and an aircraft reference (i.e., nose of the aircraft) for the performance of earth-referenced maneuvers.

Flight Dynamics.

___13. Flight dynamics of the simulated aircraft should be comparable in performance and handling to a single-engine, fixed gear, basic training aircraft with a fixed-pitch propeller.

___14. Aircraft performance parameters (maximum speed, cruise speed, stall speed, maximum climb rate) should be comparable in performance and handling with a single-engine, fixed gear, basic training aircraft with a fixed-pitch propeller.

___15. Aircraft vertical lift component should change as a function of bank, comparable in performance and handling with a single-engine, fixed gear, basic training aircraft with a fixed-pitch propeller.

___16. Changes in flap setting should be accompanied by appropriate changes in flight dynamics.

Instructional Management.

___17. The user should be able to pause the system at any point for the purpose of receiving instruction regarding the task.

___18. For the purpose of beginning a training session with the aircraft already in the air and ready for the performance of a particular maneuver, the user should be able to manipulate the following system parameters independently of the simulation:

Geographic aircraft location (location within the available digitized space)
Aircraft heading
Aircraft airspeed
Aircraft altitude
Engine RPM.

___19. The system should be capable of recording both a horizontal and vertical track of aircraft position during the performance of a task for later playback and review.

Table 2: Extended Qualification Guidelines

Controls:

20. The PCATD should have physical controls for the following:
    carburetor heat
    mixture control
    master switch
    brake
    ignition switch.
21. The PCATD should have physical controls for the following:
    altitude setting adjustment
    heading indicator adjustment.
22. The PCATD should have a physical communications radio microphone or a push-to-talk switch.
23. The PCATD should have a physical control for a clock or timer.
24. The PCATD should have physical controls for a communications radio, navigational radio and VOR.

Displays:

25. The PCATD should have a clock or timer display.
26. The PCATD should have an oil pressure guage.
27. The PCATD should have a visual or aural indication that the engine is running.
28. The altitude indicator should have a barometric pressure indicator.
29. The out-the-window view should be capable of showing runway features and markings.
30. The PCATD should provide auditory signal to indicate contact between wheels and runway surface.
31. The PCATD should have a 90° to the left, out-the-window display, representing at least a 45° horizontal field of view, and a 30° vertical field of view.
32. The PCATD should have a 90° to the right, out-the-window display, representing at least a 45 degree horizontal field of view, and a 30° vertical field of view.
33. The out-the-window view should be capable of showing sufficient terrain features and landmarks so that course control can be maintained at all times.
34. The PCATD should have a fuel gauge.
35. The PCATD should have a navigational radio and VOR with an aural, Morse code identification feature.
36. The PCATD should have a stall warning sound.
37. The out-the-window display should be capable of showing a nighttime scene.

Flight Dynamics:

38. The presence and amount of wind are reflected in the handling and performance qualities of the simulated aircraft and are consistent with a single-engine, fixed gear, basic training aircraft with a fixed-pitch propeller.
39. Flight dynamics should allow a pilot to produce a spin and recover from a spin.
40. The handling and performance qualities of the simulated aircraft during simulated engine failure are consistent with a single-engine, fixed gear, basic training aircraft with a fixed-pitch propeller.

Instructional Management:

41. The PCATD tests knowledge of certificates and documents through multiple choice questions, fill-in-the blanks, etc. and provides feedback on areas of knowledge that are lacking.

42. The PCATD tests knowledge of weather through multiple choice questions, fill-in-the blanks, etc. and provides feedback on areas of weather-related knowledge that are lacking.
43. The PCATD provides feedback regarding the selection of route segments and checkpoints, the computation of headings, distances, airspeed, wind data, groundspeed, time enroute, estimated time between check points, fuel required, weight and balance, and the correct procedures for completing and filing a flight plan.
44. The PCATD tests knowledge of the national airspace system through multiple choice questions, fill-in-the blanks, etc. and provides feedback on areas of knowledge that are lacking.
45. The PCATD tests knowledge of aircraft peformance and limitations through multiple choice questions, fill-in-the blanks, etc. and provides feedback on areas of knowledge that are lacking.
46. The PCATD tests knowledge of aircraft systems and their operating characteristics through multiple choice questions, fill-in-the blanks, etc. and provides feedback on areas of knowledge that are lacking.
47. The PCATD tests knowledge of the content and use of minimum equipment lists through multiple choice questions, fill-in-the blanks, etc. and provides feedback on areas of knowledge that are lacking.
48. The PCATD tests knowledge of aeromedical factors through multiple choice questions, fill-in-the blanks, etc. and provides feedback on areas of knowledge that are lacking.
49. The PCATD tests knowledge of preflight inspection through multiple choice questions, fill-in-the blanks, etc. and provides feedback on areas of knowledge that are lacking.
50. The PCATD tests knowledge of cockpit management procedures through multiple choice questions, fill-in-the blanks, etc. and provides feedback on areas of knowledge that are lacking.
51. The PCATD tests knowledge of ATC light signals through multiple choice questions, fill-in-the blanks, etc. and provides feedback on areas of knowledge that are lacking.
52. The instructor can control the amount of wind encountered during the performance of the task both before the session begins and during the session.
53. The PCATD tests knowledge of airport and runway marking and lighting through multiple choice questions, fill-in-the blanks, etc. and provide feedback on areas of knowledge that are lacking.
54. A navigational area database that is local to the training facility is available.
55. The PCATD out-the-window view can be blanked out or covered up.
56. Prior to beginning a simulation, the user is able to establish the aircraft's attitude, including both bank and pitch angle.
57. The instructor can control the presence of an engine failure during a training session.
58. The PCATD tests knowledge of night flying through multiple choice questions, fill-in-the blanks, etc. and provides feedback on areas of knowledge that are lacking.

Table 3: Private Pilot Training Task Checklist										
√*	**Task**	**Extended Guidelines**								
	1.0 Preflight Preparation									
	1.1 Certificates and Documents	41								
	1.2 Weather Information	42								
	1.3 Cross-Country Flight Planning	43								
	1.4 National Airspace System	44								
	1.5 Performance and Limitations	45								
	1.6 Operation of Systems	46								
	1.7 Minimum Equipment List	47								
	1.8 Aeromedical Factors	48								
	2.0 Preflight Procedures									
	2.1 Preflight Inspection	49								
	2.2 Cockpit Management	50								
	2.3 Engine Starting	20	26	27						
	2.4 Taxiing	29								
	2.5 Pretakeoff Check	20	21	26	28	29				
	3.0 Airport Operations									
	3.1 Radio Communications	22								
	3.2 ATC Light Signals	51								
	3.3 Traffic Pattern Operations	29	31	38	52					
	3.4 Runway Marking and Lighting	53								
	5.0 Takeoffs, Landings, Go-Arounds									
	5.1 Takeoff and Climb	29	38	52						
	5.2 Approach and Landing	29	30	31	38	52				
	5.3 Go-Arounds	29	38	52						
	5.4 Forward Slips to a Landing	29	38	52						
	5.5 Short-Field Takeoff and Climb	29	38	52						
	5.6 Soft-Field Takeoff and Climb	29	38	52						
	5.7 Short-Field Approach and Landing	29	30	31	38	52				
	5.8 Soft-Field Approach and Landing	29	30	31	38	52				

* Checkmark next to a task indicates that the task will be trained using the PCATD

Table 3: Private Pilot Training Task Checklist - Cont.										
√*	**Task**	**Extended Guidelines**								
	6.0 Ground Reference Maneuvers									
	6.1 Rectangular Courses	31	32	33	38	52				
	6.2 S-Turns Across a Road	31	32	33	38	52				
	6.3 Turns Around a Point	31	32	33	38	52				
	7.0 Navigation									
	7.1 Pilotage and Dead Reckoning	23	25	31	32	33	34	38	52	
	7.2 Navigation Systems, Radar Services	22	24	35	38	52	54			
	7.3 Diversion	22	23	24	25	31	32	34	35	55
	7.4 Lost Procedures	22	23	24	25	31	32	33	34	35
	8.0 Slow Flight and Stalls									
	8.1 Flight at Slow Airspeeds	36								
	8.2 Power-Off Stalls	36								
	8.3 Power-On Stalls	36								
	8.4 Spin Awareness	33	36	39						
	9.0 Basic Instrument Maneuvers									
	9.1 Straight-and-Level Flight	55								
	9.2 Constant Airspeed Climbs	55								
	9.3 Constant Airspeed Descents	55								
	9.4 Turns to Headings	55								
	9.5 Unusual Flight Attitudes	55	56							
	9.6 Radio Communications	22	24	35	54	55				
	10.0 Emergency Operations									
	10.1 Emergency Descent									
	10.2 Emergency Approach and Landing	20	31	32	33	34	38	40	52	57
	11.0 Night Operations									
	11.1 Night Preparation	58								
	11.2 Night Flight	23	25	29	31	32	33	37	54	

* Checkmark next to a task indicates that the task will be trained using the PCATD